SCIENTIFIC AMERICAN

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4.—Carpentry Class.

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5.—Machine Shop.

7.—Fresco and Upholstery Decoration.

8.—Class in Moulding.

9.—Stenography and Typewriting.

TRADE SCHOOLS AT THE NEW YORK STATE REFORMATORY—[See page 9.]

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A RETROSPECT OF THE YEAR 1897.

In the year which has just drawn to a close the event of greatest international importance was the Graeco-Turkish war. Whatever may have been the ulterior motives which prompted the leaders of the Greek government in the declaration and conduct of the war, there has never been a doubt as to the sincerity and bravery of the peasant soldiery. The loss of prestige which the ancient race has suffered in this unfortunate struggle is to be attributed entirely to the wretched incapacity of the political and military leaders, an incapacity which is rendered the more conspicuous by the striking ability and bravery exhibited in one or two only too rare instances. To those who were looking for the speedy death of "the sick man of Europe," the unexpected efficiency of the Turkish army has come as an unpleasant surprise. The triumph of the Turkish arms has materially strengthened the position of the Sultan in the game of European politics, and as far as Turkey is concerned the solution of the Eastern question is further off than ever before. Second in importance to this war is the border conflict which is being carried on in India between the British troops and the fierce mountain tribes of the northwest. In spite of the large force that has been led against them, the rebel tribes are showing as bold a front as they did at the outbreak of hostilities, and the close of the year finds the situation full of grave possibilities for the British government. The insatiable desire of the younger civilizations to partition the countries of the older civilizations among themselves, either by open seizure, conquest, annexation, or so-called protectorates, is manifest on every hand. England maintains her hold on Egypt and is steadily pushing into the Soudan; Germany has just seized a Chinese port, Russia has placed her fleet at Port Arthur; and even the United States is seriously considering a departure from her time-honored policy in the annexation of Hawaii. The rebellion in the Philippines has been suppressed by Spain, but the Cuban struggle still drags wearily on, with no evidence that Spain is capable of bringing it to a close.

In the industrial world the year has been remarkable both for the promise which it gives for the future and the increasing prosperity which has marked its course. The steady increase in our exports proves that we are strengthening our hold on the markets of the world, and in certain lines we are easily underselling the foreign manufacturer in his own markets. Perhaps the most significant event was the securing of the contract to equip the new underground electric road in London by an American firm. This event caused a positive consternation among English electrical manufacturers. We have also secured large orders for mining machinery, locomotives, etc., from British colonies, the contracts being awarded in the face of active competition from the mother country.

The year will long be memorable for two events which have contributed to restore confidence and add materially to the national wealth. Reference is made to the discovery of the extraordinary wealth of the Yukon gold fields and the phenomenal crops with which the Western farms have been favored.

The year has not been conspicuous for any large number of works of magnitude that have been completed in the field of civil engineering. London has seen the opening of the Thames Tunnel, which has the distinction of being the largest in diameter of any ever built, and Boston celebrated the opening of a street-car subway built to relieve the severe congestion in the heart of the city. The close of the year finds the impediments in the way of the construction of the proposed underground railroads in New York being gradually removed, and it is likely that early in the present year this stupendous undertaking, involving the expenditure of over $30,000,000, will be well under way. Preliminary steps have been taken toward the building of a tunnel connecting the lower end of New York with Brooklyn. Work has been prosecuted steadily on the new East River Suspension Bridge connecting New York and Brooklyn. The caissons for the pier foundations are being sunk, and the contract for one of the anchorages has been let. This magnificent structure will have a central span of 1,600 feet; it will provide six railroad and trolley tracks, two roadways and two walks for pedestrians. The total width of the floor will be 118 feet, and it will be carried by four 18-inch cables. A noble steel arch has been completed over the Niagara River to replace the famous old railroad suspension bridge, and early in the year the great four-track viaduct and drawbridge over which the tracks of the New York Central Railroad enter New York City was opened. This is the largest four-track drawbridge in the world. Adjoining it is another massive drawbridge which crosses the Harlem on the line of Third Avenue. This structure, which weighs 2,500 tons, has been completed this year and will shortly be thrown open for public use. The contract has been let for the rebuilding of the historic Victoria Tubular Bridge across the St. Lawrence River at Montreal, and before many months the work of replacing the antiquated square tubes with modern pin-connected trusses will be well under way. An exceedingly handsome steel arch bridge was opened across the Wupper Valley at Mungsten, Germany. The arch has a span of 524 feet and the total length of the bridge is 1,600 feet. A notable event in municipal engineering was the opening of a station at Shoreditch, London, in which electric light is furnished by a plant in which the steam is generated by the combustion of city refuse. Increased attention is being given to the question of the disposal of city wastes, and the good work of this kind which has been done in New York has been duly chronicled in this journal.

In steam engineering the most notable fact is the great revival of interest in that class of rotary engines known as steam turbines, of which the Parsons, the Laval and the Dow are the best known. The Parsons turbine has been brought into worldwide prominence by its remarkable success in ship propulsion as shown on the torpedo boat "Turbinia." The triple expansion turbines of this boat, which weigh only about 4 tons, have developed 2400 horse power with a steam consumption of only 14 pounds per horse power. Experience has shown that the larger the motors the better is the relative performance, and the present year will see the launching of two boats for the Russian government that are to have a contract speed of 38 knots an hour. The tendency in steam engine practice is still in the direction of higher steam pressure and greater piston speed. A notable departure in boilers was the construction of two nickel steel boilers for the United States cruiser "Chicago." The water tube boiler has continued to demonstrate its efficiency, and the successful trials of the "Powerful" and "Terrible" of the British navy have demonstrated the great superiority of this type over the Scotch boiler, at least for naval purposes.

The electrical engineer still continues to maintain his successful invasion of the fields once exclusively held by the steam engineer. This is very noticeable in the operation of factories and machine shops, where independent electric motors working directly at the machines are rapidly taking the place of shafting and belting, with a saving of space and a greater convenience in manipulation. The electric motor is becoming simply ubiquitous, and it is being put to a thousand and one uses for which its compactness and mobility render it eminently adapted. Electric traction is also steadily supplanting steam traction on suburban and interurban lines, and the undoubted success of the third-rail system on the Hartford-New Britain lines of the New Haven Railroad has proved to the satisfaction of that company that it is better adapted than steam for such work. The only serious attempt to use electric traction on main lines is now being made in France, where the curious Heilman locomotive is being tested with what are reported to be promising results. The third-rail system is also to be installed on the Central Underground Railway, London, for which the contract was let to an American firm this year. The great work of equipping some 50 miles of the street railways of New York with the underground trolley was carried out in the latter half of the year just closed, and work has been started on a huge central power house, which is to have a capacity of 70,000 horse power. The intention of the company which is making the change is to equip the whole of its 200 miles with the underground trolley, discarding the cable on its Broadway and Lexington Avenue lines. The utilization of the world's water power by conversion into electric current goes on apace, and the year has seen the transmission of power from Niagara to Buffalo; the opening of the great Lachine Rapids hydro-electric plant near Montreal, which is to have a capacity of 20,000 horse power; and the active construction of the great plant at Rheinfelden, Germany, which is to generate from 15,000 to 18,000 horse power. The successful work which has been done in electric towage on canals is promising for its future extension.

In recording advancement in the electrical field mention must be made of the feats in high-speed telegraphy performed by Lieut. Squier and Prof. Crehore, who, by making use of the alternating current and special designs of receiver and transmitter, succeeded in sending messages over a wire at the rate of 1,200 words a minute. A sensational invention of the year was the device of Marconi, a young Italian, who utilized the Hertzian vibrations for telegraphic purposes. He has succeeded in transmitting telegraphic messages over a distance of eight miles without the use of wires. The invention has been taken up by the British Post Office authorities, who are carrying out exhaustive experiments.

In the broad field of transportation covered by the railroad and steamship there has been a steady advance during the past year. Railroad construction in this country has been carried forward on the conservative and legitimate lines which marked the operations of the previous year. Only about 2,000 miles of road have been built—a not inconsiderable amount judged by itself; but a small total compared with the reckless operations of a previous decade, when as much as 12,000 miles was built in a single year. The plentiful crops and restored credit of the past twelve months have materially improved the finances of the railroads, and

in conjunction with a more economical administration are serving to redeem many properties from insolvency. The remarkable activity of the German Atlantic steamship companies, and especially of the North German Lloyd and the Hamburg American lines, has resulted in the addition of several gigantic liners to the great fleet of transatlantic steamships. The former company has placed on the route a truly magnificent ship in the "Kaiser Wilhelm der Grosse," which in the first few months of its service has captured every record on the ocean. On her maiden trip she covered 564 knots in one day, and on her last eastward trip she made the highest hourly average for the whole passage—22·34 knots per hour. A sister ship, the "Kaiser Friedrich," was launched late in the year, and she is expected to make her first voyage early in the spring. The Hamburg American line has placed in service the largest freight steamer in existence, the "Pennsylvania," and has also launched a sister ship, the "Pretoria." These vessels are nearly 600 feet long and have a loaded displacement of over 23,000 tons. The "Oceanic," a new express passenger ship for the White Star line, has also been laid down in the yards of Harland & Wolf at Belfast, and when she is afloat she will surpass many of the dimensions of the "Great Eastern" herself. Her length will be 704 feet.

The year has seen the launch and trial of two curious boats of the "roller" type—one built by Bazin, in France, and the other by Knapp, in Canada. They were both built upon the theory that a ship will roll over the water more easily than she will plow her way through it. Both have, so far, failed to verify the theories of their designers. Perhaps the most significant fact in marine transportation, in this country, has been the wonderful increase in the number and character of the fleet of vessels engaged in the carrying trade of the Great Lakes. In volume the American trade in these inland seas is greater than that on the ocean, and the ships which have been launched in increasing numbers this year have shown a great advance in size, speed and accommodation.

In regard to naval affairs in the United States, the year has been quiet and uneventful, compared with its predecessor, when so many fine ships were placed in commission. The most notable addition to the navy has been that fine battleship the "Iowa," which made a speed of 17 knots on her trial, or 2 knots more than her contract called for. The "Porter," a torpedo boat destroyer, the first of the type to be built for our navy, made 28·74 knots on her trial, and has given good results during the time she has been in commission. The enforced trip of the "Indiana" to Halifax, for docking, has resulted in an urgent demand for more dry docks, and this serious want is now likely to be met by the construction of nearly a dozen dry docks of various dimensions.

Among foreign nations England and Japan are conspicuous for the vast additions which they are making to their fleets. The former, in spite of her present enormous fleet, continues to build new ships in increasing numbers, the appropriation for the past year being $115,000,000. The ships under construction during the year comprising 14 battleships, 27 cruisers, 52 torpedo boat destroyers and various other craft. Japan is adding to her fleet at a rate which will soon make her mistress of the Pacific Ocean. She has battleships and cruisers of the very latest types building in the best English and American yards. Her new battleships will be thoroughly up to date and of superior speed and power to any afloat in the world to-day.

The most notable advance in the manufacture of armor has been made by Krupp, who has combined all the surface hardness of the Harvey plate with an extraordinary toughness. The wire-wound gun continues to gain favor, and, while no startling developments have appeared in the manufacture of ordnance, there has been a marked increase in shell velocity and in energy per ton weight of the gun.

Two expeditions have returned from polar regions after successful work. Lieut. Peary brought back with him the large meteorite, of the existence of which he had learned during his previous trip, and the Jackson-Harmsworth English expedition returned in safety after the party had carefully mapped out Franz Josef Land. A pleasing incident that speaks volumes for the broad-minded spirit and generosity of Mr. Harmsworth was his offer of his ship, the "Windward," to Lieut. Peary for his forthcoming trip to the pole.

Archæology has been greatly enriched by the discoveries of the great French archæologist, J. De Morgan, in Egypt; and Messrs. Grenfell and Hunt have delighted the theological world by their discovery in Egypt of a vast collection of papyri, among which was a leaf from a third century papyrus book containing a collection of the sayings of Christ.

Nothing in the history of aeronautics, surely, has attracted greater attention than Andrée's attempted balloon voyage to the North Pole. Although some months have elapsed since he was swept by a southerly wind into the unknown North, not a trace of him has been found at the present writing. It is only his well known resourcefulness and daring, and his own oft-repeated assertion that he would be heard from again, that sustains the hope that he has not long ago perished. The most practical work in ballooning has been done by the military schools in England, Germany and France. Germany has produced two remarkable novelties in the Parseval kite balloon and the unfortunate Schwarz aluminum balloon, the latter of which came to grief at its first trial.

Aeronautics have also been pressed into the service of meteorology and photography, and the photographs which have been secured by sending up kites to which cameras were attached show that there is a successful future for this new development of photography.

We close our brief review of the year with mention of the opening of the Yerkes Observatory, at Williams Bay, near Lake Geneva, Wisconsin. The great object glass of the telescope, 40 inches in diameter, is the largest in the world, the next in size being that of the Lick telescope at Mt. Hamilton, California. Both of these were the gift of private individuals and they assist greatly in giving the United States their present high standing in the astronomical world.

NEW YORK RAPID TRANSIT REPORT APPROVED BY THE APPELLATE JUSTICES.

It is a bitter disappointment that the decision of the Appellate Division of the Supreme Court upon the report of the Rapid Transit Commission should have left the question as to how soon the road will be built as much in the air as it was before the judgment was rendered.

In view of the fact that the plans embodied in the present report had been drawn up to meet the objections raised by the courts to the scheme as first presented, there was little doubt in the minds of the citizens of New York that the justices would approve the present plans as being both adequate and feasible.

The chief concern of the friends of rapid transit—who constitute to-day as they did years ago, when the question was put to the popular vote, practically the whole of the traveling public—was to know whether the increase in the indebtedness of the city due to the building of the tunnel would swell the total indebtedness beyond the constitutional limit of 10 per cent of the city's assessed valuation. This was the question upon which the opponents of rapid transit had mainly taken their stand in the last hearing before the commission.

It was urged by the opposition—who constitute, by the way, an exceedingly small minority of the property holders along the route of the road—that although the construction of the road will only entail each year an expenditure of $6,000,000, the city will at once become indebted for the full amount of $30,000,000, representing the cost of the completed work, on the very day that the contract is let. It was claimed by the Rapid Transit Commission, on the other hand, that the indebtedness is only increased as the payments for construction become due, and that the yearly increments of $6,000,000 or thereabout will never carry the total indebtedness of the city beyond the constitutional debt limit. It is argued by the commission that the city does not incur the full debt at once, any more than a tenant who takes a lease for ten years at $10,000 a year can be said to incur a present debt of $100,000.

The appellate justices, however, consider the question of such serious gravity that they refrain from passing upon it, and suggest that it should be submitted to the Court of Appeals, to which, of course, it will be carried by the lawyers, to whose brilliant fertility of resource the unexpected agitation of this question is due.

More serious, however, and full of menace to the welfare of the scheme, is that clause of the justices' decision relating to the nature of the bond which must be given by the parties who contract to build and operate the road. The Rapid Transit act very properly requires that a sufficient bond shall be given to safeguard the interests of the city and secure prompt construction and efficient operation of the road. In their present decision, the justices state that the bond should be placed at the manifestly impossible figure of $15,000,000. The magnitude of the bond will be understood when it is remembered that the contract, and, therefore, the bond, must extend over a period of fifty years. All the security companies in New York, united, could not go security on such a bond; and even if they could, there is not a contracting firm or syndicate of firms in the world that would face the responsibility of furnishing it.

It is difficult to understand what is the exact attitude of the appellate justices toward the present amended scheme. Their decision opens with a recognition of "the imperious necessity of improved means of rapid transit," and with a complete indorsement of the amended plan of its commission; yet it closes with a recommendation which, if carried out, will bury rapid transit in its present form beyond all hope of resurrection. The decision has produced a painful impression, in that the justices seem deliberately to praise the scheme with one breath and blast it in the next, and it is sincerely to be hoped that the compromise bond, which the commission will name when they present their order to court, will be approved.

The question of the debt limit will find its way to the Court of Appeals, where the probability is that it will be decided favorably to the commission. The enlarged city of Greater New York, under the new charter, will have a larger borrowing capacity, due to the increased valuation of real estate. The rate of valuation is at present much higher in Brooklyn than it is in New York and the Bronx, but in the consolidated city all the territory must, of necessity, be assessed at about the same rate. The Brooklyn rate cannot be lowered, and hence that of New York must be raised to its level. If this is done, the increase in valuation will be about 25 per cent, which would add about $450,000,000 to the present assessed valuation of New York City, and would provide an increase of the debt limit of $45,000,000. From these figures it is evident that even if the whole cost of the underground road be reckoned as a present debt, there will be an ample margin within the constitutional debt limit.

THE CAMPHOR TREE.

An account of the range, cultivation, uses and products of the camphor tree (Cinnamomum camphora) is given in a circular (No. 12) just distributed by the United States Department of Agriculture (division of botany), and is thus commented upon by Nature: Notwithstanding the comparatively narrow limits of its natural environment, the camphor tree grows well in cultivation under widely different conditions. It has become abundantly naturalized in Madagascar. It flourishes at Buenos Ayres. It thrives in Egypt, in the Canary Islands, in southeastern France, and in the San Joaquin Valley in California, where the summers are hot and dry.

Large trees, at least two hundred years old, are growing in the temple courts at Tokyo, where they are subject to a winter of seventy to eighty nights of frost, with an occasional minimum temperature as low as 12° to 16° Fah. The conditions for really successful cultivation appear to be a minimum winter temperature not below 20° Fah., 50 inches or more of rain during the warm growing season, and an abundance of plant food, rich in nitrogen. In the native forests in Formosa, Fukien and Japan camphor is distilled almost exclusively from the wood of the trunks, roots and larger branches. The work is performed by hand labor, and the methods employed seem rather crude.

The camphor trees are felled, and the trunk, larger limbs, and sometimes the roots are cut into chips, which are placed in a wooden tub about forty inches high and twenty inches in diameter at the base, tapering toward the top like an oldfashioned churn. The tub has a tight-fitting cover, which may be removed to put in the chips. A bamboo tube extends from near the top of the tub into the condenser. This consists of two wooden tubs of different sizes, the larger one right side up, kept about two-thirds full of water from a continuous stream which runs out of a hole in one side. The smaller one is inverted with its edges below the water, forming an airtight chamber. This air chamber is kept cool by the water falling on the top and running down over the sides. The upper part of the air chamber is sometimes filled with clean rice straw, on which the camphor crystallizes, while the oil drips down and collects on the surface of the water. In some cases the camphor and oil are allowed to collect together on the surface of the water, and are afterward separated by filtration through rice straw or by pressure. About twelve hours are required for distilling a tubful by this method. Then the chips are removed and dried for use in the furnace, and a new charge is put in. At the same time the camphor and oil are removed from the condenser. By this method twenty to forty pounds of chips are required for one pound of crude camphor.

THE "FIRE FIEND" AS A DYER.

Elberfeld, Germany, was recently the scene of a fire which will probably result in a crop of lawsuits against the Elberfeld Aniline Color Works for damages caused to goods, furniture, clothing, etc., by flying particles of color borne far and wide by the wind during the progress of the blaze, says Fire and Water. Within a radius of ten kilometers from the place of the fire serious damage was done to wash on the line, household furniture, newly painted houses, and open stock of merchandise by those flying particles of aniline of all colors and shades which were deposited on the injured articles from the burning factory. In the Roman Catholic church of St. Laurentius, at Elberfeld, the vestments have been stained to such an extent that they more nearly resemble the dresses worn by a harlequin in a pantomime. Fire underwriters, to whom innumerable claims for damage have been presented, deny liability, and the opinion prevails in legal circles that the color works can be made responsible, if it can be shown that the fire occurred through some negligence on the part of the company or its employes. Other lawyers claim that the value of any insured furniture, clothing, or other goods injured in the way above mentioned can be recovered from the insurance offices direct, as the loss was as clearly traceable to fire as any from water or smoke only in cases where the goods are not hurt by the fire—leaving it to the insurance offices to recover from the Aniline Color Works.

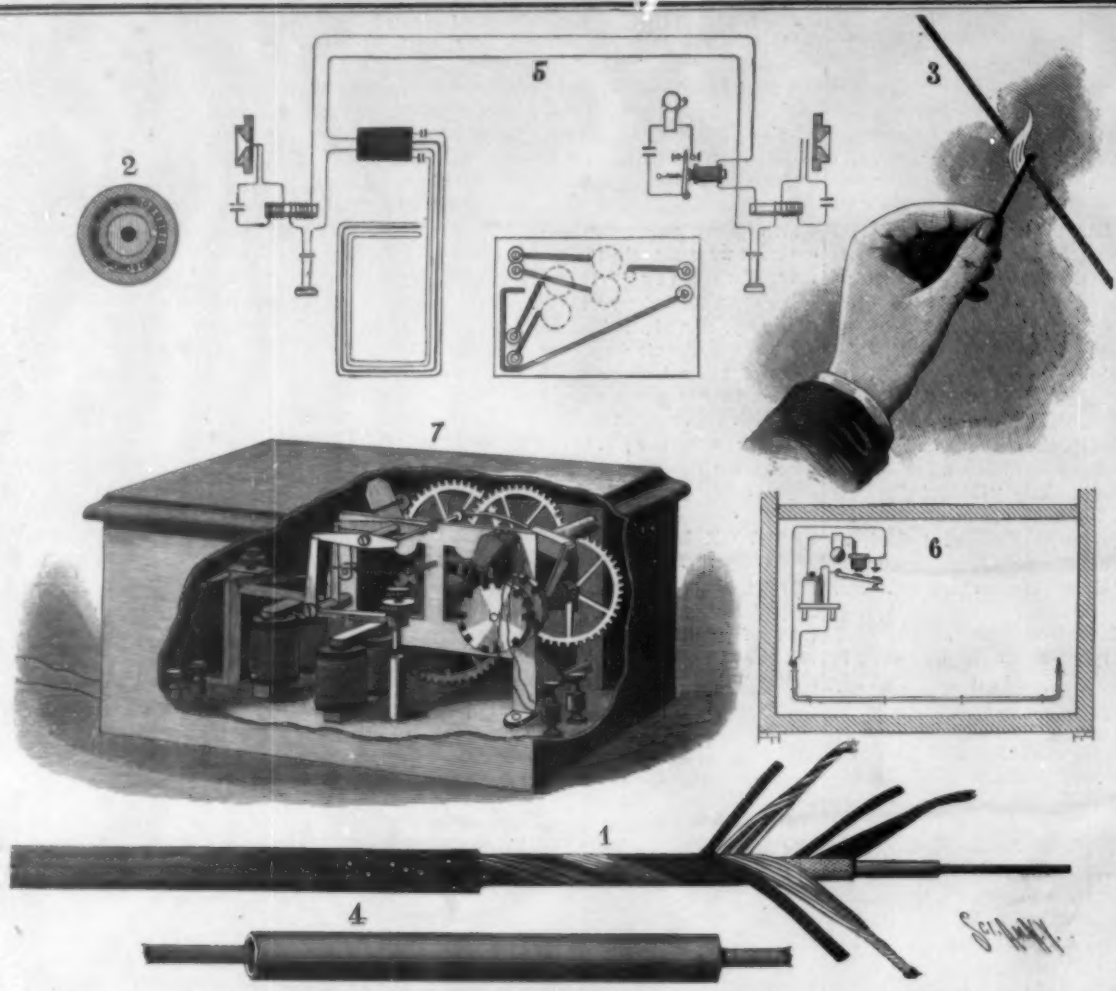
THE MONTAUK MULTIPHASE FIRE CABLE.

The United States have won a well deserved reputation for the high state of efficiency to which they have brought their appliances for fire extinguishment. It is generally admitted that the best fire departments of other countries are greatly inferior to the splendid institutions which are maintained in our leading cities. Not only is our equipment for "fighting fire" practically perfect, but there has been a wonderful amount of ingenuity displayed in the invention of devices for automatically locating and announcing an outbreak of fire. These inventions have taken the form of thermostats, which automatically close an electric circuit when the local temperature passes a certain point. The thermostats are scattered throughout a building in various places which in the judgment of the owner are most likely to be visited by a fire. If the outbreak should occur immediately below a thermostat, the circuit will be closed and the alarm rung in immediately. If, however, the fire should start at a point intermediate between two thermostats, there would be more or less delay until the temperature reached the proper degree to operate the alarm.

The ingenious and well-thought-out system of fire alarm which we illustrate in the accompanying engravings is the logical development of the usage of the thermostat above referred to. In place of a set of wires connecting a number of isolated thermostats, the whole wire itself is so sensitive that the mere heat of a lighted match (see Fig. 3) applied at any point of the wire will cause the metal to fuse and ring in an alarm. As the value of a fire alarm consists chiefly in the rapidity with which it will act, upon the outbreak of a fire, it is evident that the efficiency of the "fire cable" is enormously increased over that of ordinary systems.

The construction of the cable and the details of the wiring are shown in the accompanying figures. The cable, Fig. 1, is made up of an inner copper wire, which is coated with a metal that fuses at the low temperature of 374 degrees. The fusible metal alone would serve to carry the current, but the copper is introduced to increase the conductivity. Around the fusible metal is wrapped a suitable insulation, and over this again is wrapped a series of smaller wires with insulations between them, as shown in the sketch, the whole being covered with an outer protective wrapping. One of the outer wires serves the fire alarm, another the burglar alarm, another may be used for the servants' call, and others may be added to serve a multiplicity of electric connections.

When a fire breaks out in the neighborhood of the wire, the heat fuses and expands the inner fusible coating and forces it out through the insulation into contact with the overlying return wire, thus forming a metallic contact between the inner and outer wire, closing the circuit and turning in an alarm. Fig. 6 shows the cable laid in a room and connecting with an audible fire alarm in the house.



1. The cable. 2. Cross section of cable. 3. Fusing cable with a lighted match. 4. Cable in pipe for use on ships. 5. Wiring for house fire-alarm connected with central fire station. 6. Wiring of room and alarm connections.

DETAILS OF MULTIPHASE CABLE FIRE ALARM.

Fig. 5 is a diagram showing the cable connected to an automatic circuit-controller in the house or on the street, through which the alarm is automatically forwarded to the central fire station.

When the circuit is automatically closed by an outbreak of fire, the current energizes the magnets in the controller (Fig. 7), which then act upon a system of small levers and release a clock mechanism. The latter serves to rotate the two controlling disks, which, by means of make and break contacts, ring up the call corresponding to the location of the fire and show the corresponding number in the annunciator. The disks are so arranged that they repeat the alarm at the central station.

A valuable feature of this cable is that it forms an effective burglar alarm; for if a burglar should attempt to destroy the ordinary window alarm by breaking the window glass and cutting the wires, the pliers will form a metallic connection between the inner and outer wires of the cable and close the circuit, as shown in our illustration. To avoid error in connecting up the return wires they are made in different colors. Thus the fire alarm wires are of copper, another set are copper wires tinned, and a third will consist of alternate tinned and copper wires (see Fig. 1). To keep down the bulk of the return wires each set consists of several fine wires whose aggregate cross section is sufficient to make up the necessary conducting area, and they are wrapped in ribbon fashion around the insulation. Considering the complicated nature of the cable and the duty that it performs, its bulk is remarkably small.

The advantages of the cable are obvious. Not only does it provide a building with continuous lines of protection, but the sensitive wires themselves are so small as to attract no more attention than ordinary house wiring. It may be laid along the moulding, across a window or door, within the cornice, above the shelves in a store, as in our illustration, without attracting the eye, or in any way interfering with the decorative features of the building. For detecting a fire, due to spontaneous combustion in the coal bunkers or hold of a ship, the wires would be laid in pipes which would protect them from rough usage but leave them exposed to the action of heat. The various patents which cover this device are owned by the Montauk Multiphase Cable Company, 100 Broadway, New York, to whom we are indebted for the particulars given above.

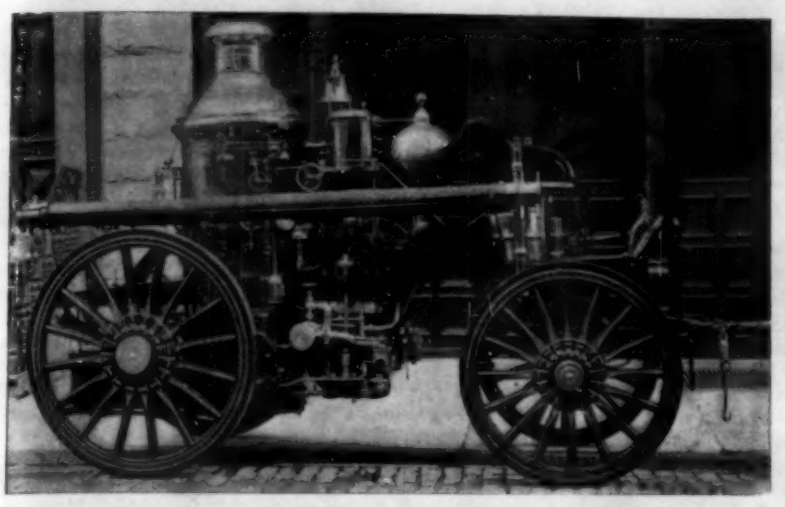
ALARM GIVEN BY BURGLAR CUTTING WIRES.

FIRE ALARM GIVEN BY WIRES STRUNG ALONG CORNICE.

FIRE ENGINE BALL BEARINGS FOR THE NEW YORK FIRE DEPARTMENT.

The remarkable results obtained by the use of ball bearings in the bicycle have led to a great many attempts to apply the device to heavy machinery and to wearing parts which are subject to heavy loads.

It cannot be said that the ball bearing has proved as successful for heavy as for light work, and the failure has been due to the difficulty in providing a construction which would stand the great wedging or bursting strain which is exerted upon the balls and ball races. In the case of railroad cars, or the heavy drays used in city traffic, where the wheels and bearings are subjected to the shock of passing over joints, switches and crossings, or pounding over badly worn paving, it has been extremely difficult to provide balls and races that would not cut or fracture, and an adjustment that would remain secure when once it was set up.

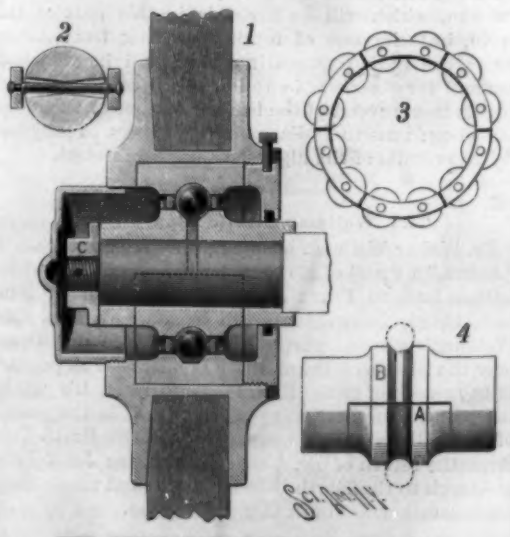


FIRE ENGINE OF THE NEW YORK FIRE DEPARTMENT—WHEELS FITTED WITH BALL BEARINGS.

We present the accompanying views of ball bearing in which a successful attempt has been made to overcome these difficulties. It was designed and patented by Dr. W. J. Tripp, of No. 359 Lenox Avenue, New York City, and has recently been applied to fire engine No. 18, of the New York Fire Department, where it is giving good results.

The engine weighs 5½ tons, and the driver states that since the new bearings were introduced the draught has been considerably lightened. The reduction of friction is very noticeable in the engine house when this engine is moved by hand, in comparison with one fitted with plain bearings.

In the construction of the bearing no attempt has been made to carry the load upon the faces of two separate adjustable cones, as in the ordinary type. The cones, B, Fig. 4, are only in contact with the upper half of the circle of balls, the lower half of the cones being cut out and a cast steel bearing block, A, inserted. The lower half of the ball race is turned in this block, and the wearing surfaces are given intense hardness by treatment with the Harvey process. It will be seen that this block really takes the place of the brass in an ordinary journal, and, like it, can be removed and another inserted when it is worn out. This part of the race being made in one piece, there is no wedging thrust transmitted to the other parts tending to rupture them and loosen up the bearing.



THE TRIPP IMPROVED BALL BEARING.

It is claimed for the common type of ball bearing, in which the balls touch each other, that there is no sliding friction. While this is true as regards contact of balls with races, it is not true as regards contact between the balls themselves, for in the latter case the touching surfaces are moving in opposite directions and must slide upon each other. In the present case each ball is mounted on an axle, Fig. 2, and the axles are riveted into two segmental side rings, Fig. 3. The balls are mounted in pairs, the rings being cut in segments for convenience of insertion in the bearing and to give the greatest possible freedom of movement to the balls. The hole through the balls is bored with a double taper, so as to reduce the bearing surface of the axle on the ball and avoid friction. By this arrangement the balls are prevented from contact and all sliding friction between them is avoided.

The inner cone is locked in place and prevented from rotation on the axle by forming it with a recess which fits over the square shoulder of the axle. The outer cone is held in place by the nut, C, Fig. 1. The cup bearing is fitted into the cast steel hub with a snug fit and is held in place by a threaded cap which is locked by a set screw. The outer end of the bearing is closed with a dustproof cap which is screwed into the metal of the hub.

It will be noticed that the balls are unusually large—one and three-quarters inches in diameter. They are made of tool steel and carefully hardened. There is an advantage in the use of one row of balls for ordinary bearings, but where heavy work is required it is advisable that a double row of balls operating on the same principle be used.

THE TELESCRIPTOR.

The uncouth word "telescriptor" has been coined for the name of a most ingenious and compact type-printing telegraph instrument, the invention of an Austrian electrical engineer, Herr Bernhard Hoffmann. The machine is not to be regarded as a competitor of the well-known Hughes instrument, as simplicity of operation has been aimed at in the first place, and speed only perhaps as a third desideratum, ranking only after compactness. The apparatus seems especially suitable for replacing the old Wheatstone A B C instrument wherever it is still used, and for taking the place of the telephone on private lines, when it is desired to keep records of the messages sent and received. Fig. 1 shows the general appearance of the instrument; its overall dimensions are 16 inches by 15 inches by 12 inches high. The keys corresponding to the letters are arranged in alphabetical order, and each key also controls a sign or figure. The two extra keys for changing from letters to figures, and vice versa, also serve as spacers, and it is unnecessary to hold these keys down while the other keys are being depressed, as it is in the case of typewriters of the Remington pattern.

The same instrument is used both for sending and receiving, and the instructions for operating are extremely simple. Two levers, marked "Receive" and "Transmit" (or, rather, their French equivalents, as the machines are at present made by the Société des Téléphones, of Paris) are depressed when it is desired to transmit a message, and this starts the machine running. A key marked "Synchro." is then depressed and held down until the type wheel comes to rest, and when this key has been pushed down twice the machines at the two ends are in step. A key marked "Lett." is then held down till the wheel stops, and the machine will write letters until the key "Fig." is depressed. When writing, each letter key used is to be held down until the machine stops, when it can be released, and the next letter required can be depressed. After the message is ended the "Synchro." key should be depressed and held down until the machine stops before the transmitting lever is released, in order to cut off the line current. If this is omitted, a white disk marked "Please Synchro." appears on the front of the apparatus, to remind the operator of his omission. It is intended to replace this arrangement by a locking mechanism, locking the transmitting lever until the "Synchro." key is depressed.

If an earth return be used, only one line wire is necessary, and of course the mechanism for the actual printing and for controlling the clockwork is worked through a relay, so that a more powerful local battery can be used. The type wheel is worked by clockwork, which requires winding periodically, but the escapement of the clock is controlled by an electromagnetic mechanism. The line current is unidirectional, and the relay is brought back to its second contact by a spring when the current stops. Fig. 1, which is a diagrammatic sketch of part of the connections, will help to explain the action of the instrument. The lower ends of the keys are fitted with contact rings and insulating rings (the latter are shown black in the diagram), and it is seen that they are arranged alternately, making and breaking contact with their respective contact springs in their normal positions. One set of these contact springs is connected to the battery, the other spring of each key to one segment of a revolving contact wheel seen on the top right hand of the diagram. The current flows from the segment under the brush through the line relay and thence to the line. If all the keys are up, it is seen that, by the alternate arrangement of the key contacts, the line current is alternately made and broken; this causes the tongue of the relay to oscillate backward and forward, alternately closing the circuit of the local battery through one or other of the pair of magnets, P_1, P_2, actuating the escapement. This makes the type wheel and the contact wheel revolve continuously until a key is pressed. As soon as a key—say K—is depressed, the proper sequence of make and break is interrupted, when the corresponding segment, K, comes under the brush, and the relay, and therefore the clockwork, stops. The relative position of the type wheel and the contact wheel is so arranged that when the shaft stops, the letter corresponding to the section under the brush is just above the paper. There is a ratchet wheel, L, on the same shaft, and so long as the shaft is rotating, the ratchet, M, rides on the top of the teeth, but as soon as the wheel stops, the ratchet drops between the teeth, making contact between the lever, R, and the contact spring, S. This closes the circuit of the printing magnet, so that the paper is then lifted against the type wheel, and the letter is printed. There is in addition the usual ratchet arrangement for the feed of the paper, so that as soon as the latter drops again it is moved forward one space.

Fig. 2.—THE "TELESCRIPTOR."

The relays of the instruments at either end are connected in series through the line, so that the instru

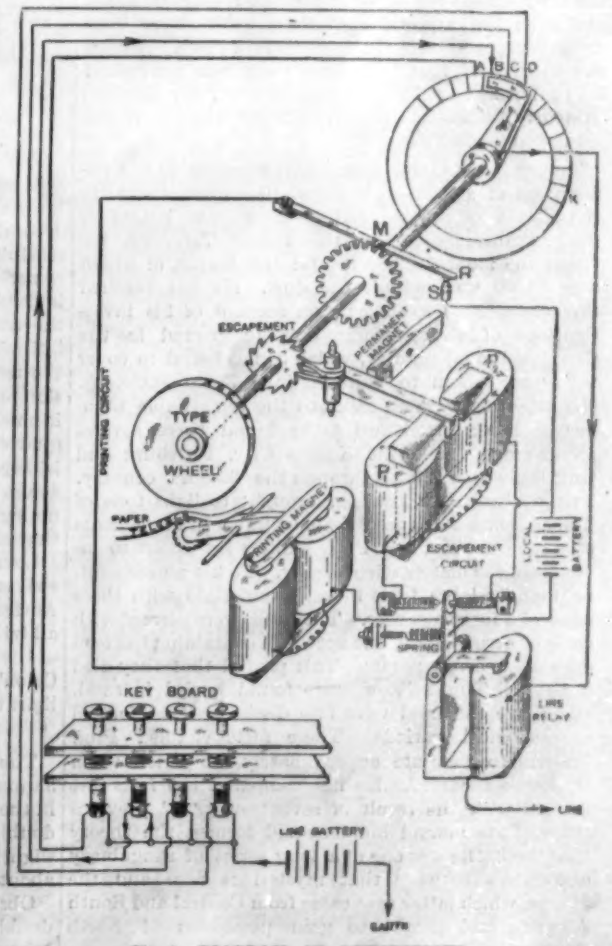


Fig. 1. DIAGRAM OF CONNECTIONS.

ment at the receiving end acts in precisely the same way as the one at the sending end. The synchronizing device remains to be explained, however. In order not to complicate Fig. 1, it has not been included in that diagram. The key, already mentioned, marked "Synchro.," is in reality merely a reversing key, and it is used in connection with a polarized relay in each of the two instruments. The coil of this relay is connected in series with the coil of the line current relay already mentioned, and when the current is flowing in its normal direction the polarized relay is unaffected. When, however, the current is reversed, the tongue of the relay is attracted. The contacts of the relay are so connected to the local circuit and to contact rings on the contact wheel that when the tongue of the relay is over, the local circuit is disconnected as soon as the wheel reaches a certain zero or starting position, which is the same on both machines.

An idea of the speed of working is gathered from the fact that the line current relay makes a complete oscillation 14 times in a second (i. e., it receives 14 currents per second), and this corresponds to 26 letters, or a complete revolution and two letters. Thus it is seen that the maximum time taken to print a letter is slightly less than one second, and that the average time is, roughly, half a second. An exaggerated legato—not the staccato of the typewriter—touch should be used in playing on the keys. For instance, if the letter E is to succeed the letter D, it would be difficult to get the second key down within $\frac{1}{28}$ of a second after the first one had been released, but the second key may be depressed just before the first is released, and so a second is saved.

It is stated that the capacity of the line does not interfere with the working of the apparatus, satisfactory experiments having been made on a 13 m. f. line at the post office with 100 volts line voltage. The line current required is from 25 to 30 milliamperes. For short lines 6 to 12 dry cells are used, according to the resistance of the line; for long lines considerably more. A battery of 9 larger sized dry cells is used for the local circuit, unless current is tapped off the supply mains.

We are indebted to The Electrician, of London, for the above particulars.

Recent Archæological News.

According to Prof. Beekman, felt was invented before weaving. The middle and northern regions of Asia are occupied by Tartars and other populous nations, whose manners and customs appear to have continued unchanged from the most remote antiquity and to whose simple mode of existence this article seems to have been as necessary as food. Felt is the principal substance both of their clothing and of their habitation.

The Chemical News states that Mr. C. Friedel has examined certain antique objects found at Abydos by M. Amélineau and considered to be anterior to the first dynasty. The fatty matter consisted chiefly of palmitic and stearic acids, and was doubtless the tallow of beef or mutton. It is interesting to find that the fatty acids, such as the stearic and palmitic acids, and even the glycerides of these acids, have been capable of preservation for thousands of years. Among the substances found in small vases was pulverized lead sulphide mixed with a quantity of fatty matter; evidently a cosmetic used as antimony sulphide is still employed in the East.

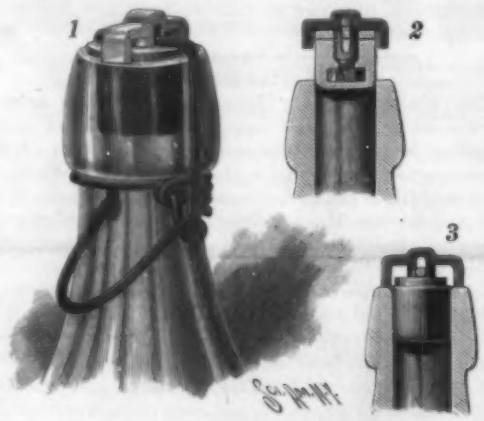
Twenty thousand years ago, according to the announcement of Prof. Walters, the archæologist, in the New York Sun, a terrible battle was fought on the Arkansas River, in the Indian Territory, between the mound builders and the Mayas, in which over 75,000 warriors bit the dust. He has reached this remarkable conclusion on account of his investigations of a prehistoric burying ground in the Choctaw Indian country, which he has found to cover thirty acres and to contain fully 75,000 skeletons. His attention was first called to the remarkable number of human skeletons to be found there several months ago, when the Kansas City, Pittsburg and Gulf Railway was built through the Choctaw country. The workmen, in grading, brought to light tons of human bones and a remarkable number of implements of savage warfare, and Prof. Walters set about to investigate the matter scientifically. To his amazement, he found a large tract literally underlaid with these relics of a forgotten race. The skulls were pierced with darts or arrow heads, one specimen containing thirteen moss agate arrow points. This proved that they died in battle. The skeletons were found buried in sand, and above the sand were two distinct strata formed in geological periods. These facts enabled Prof. Walters to compute approximately the period when the battle occurred. He has compared the facts just learned with the result of seventeen years' previous study of the mound builders, and formed the theory that the battle was one of a long series of sanguinary encounters between that mysterious race and the Mayas, which latter race came from Central and South America and sought to gain possession of North America.

The Scientific Exploration of Alaska.

Prof. Angelo Heilprin, of the Academy of Natural Sciences, Philadelphia, Pa., has organized an expedition for the scientific exploration of Alaska. Speaking of the undertaking, he stated that Lewis Nixon, the shipbuilder, would construct a stern wheel steamer of special design for navigating the Yukon River. The boat will be 80 feet long over all, 15 feet beam and 3 feet 10 inches deep. She will be built in ten sections entirely of steel, and it is estimated she will carry 35 tons on 18 inches draught of water. The boat is to be completed within sixty days. It will be shipped across the continent by rail or else sent around the Horn on one of the many steamers bound for the Klondike. The light draught of this boat will enable the explorers to pull her on the bank to transform her into a comfortable shore dwelling when winter surprises them.

A STOPPER FOR BOTTLES, JARS, ETC.

A stopper with which the necks of bottles, jars, etc., may be hermetically sealed in a simple and effective manner is shown in the accompanying illustration, and has been patented by Herman R. Melster, of Whitewater, Wis. Fig. 1 is a view in perspective showing the device applied to close a bottle neck, Fig. 2 being a sectional view representing the stopper before and Fig. 3 showing it after being pressed down. The bottle neck is fitted with the usual neck wire, on which is fulcrumed a lever carrying a bail whose middle portion extends through a vertical slot in a yoke, which has depending lugs adapted to rest on the top edge of the bottle neck, and from the middle of the yoke, below the slot, extends a support for an elastic plug, on whose top surface is a washer, the plug being adapted to pass into and be expanded in the mouth of the bottle. When the parts are in the position shown in Fig. 2 the yoke is supported from the bail, and the



MELSTER'S BOTTLE STOPPER.

stopper is held over the mouth of the bottle, but when the lever is swung downward the lugs of the yoke seat themselves on the top edge of the neck, a further downward swinging motion carrying the lever down into locked position, and pressing the stopper down into the neck of the bottle, as shown in Figs. 1 and 3.

THE JANUARY HEAVENS.

BY GARRETT P. SERVISS.

The glory of the winter heavens culminates in the evenings of January. Only one planet is well placed for observation at present, but the constellations that decorate the new year will continue to return, without sensible retardation, for many hundreds of years to come. In the popular imagination the Southern Cross, invisible from our latitudes, appears as the cynosure of the constellations, but in fact Orion, visible from all latitudes, and the chief spectacle of the winter sky in the northern hemisphere, excels every other constellation in the combined brilliancy of its stars. Placed as it now is, about 9 P. M., high up in the southeastern quarter of the celestial dome, with Sirius aflame with iridescence, following it out of the east, and viewed across a winter landscape of snow-capped hills, there is no sight on our planet more sublimely beautiful than that of Orion.

Lovers of the stars will be hardly less interested in the stellar wonders that surround Orion—Gemini, Auriga, Taurus, Perseus, Andromeda, and Cassiopeia, all lying in a brilliant row in and along the bright scarf of the Milky Way, which crosses the heavens just over Orion's head, and then falls in a stream of nebulous light to the northwestern horizon.

THE PLANETS.

The single planet conspicuously in evidence during January is Jupiter. This great belted globe is situated in the constellation Virgo, a little below the celebrated double star Gamma Virginis, and changes its place but slightly in the course of the month. On the 1st it rises about midnight and on the 31st about 10 P. M.

Observers with telescopes may witness an interesting double eclipse of the second and fourth satellites of Jupiter on the morning of January 10. The second satellite will be snuffed out in the shadow of the planet at about 3 o'clock and 51 minutes A. M. and the fourth will follow it less than a quarter of a minute later. Before disappearance both will be seen on the left of Jupiter in the telescopic field, the second being much nearer the planet than the third.

Saturn is in the constellation Ophiuchus, about seven degrees almost directly north of the great red star Antares in Scorpio, rising on the first about 5 A. M. and on the 31st about 3 A. M. I suppose the astrologers may find ground for uneasiness in this undisguised conference of two such notorious "malefics" as Saturn and Antares. But ordinary persons will only wonder at the contrast between the floridness of Antares and the paleness of Saturn.

Uranus, another planet of whose intentions I believe the astrologers are somewhat suspicious, is not far away, being situated in Scorpio, just below the fine double star Beta, and still closer to the little pair called the Omicrons. Thus located Uranus becomes easy to identify for those who will take the trouble to use an opera or field glass, and will watch it for several successive evenings. The slow southeastward motion of Uranus will, in the course of a night or two, sensibly alter its place with reference to the nearby stars, and thus serve to make the identification of the planet certain.

Mercury, Venus and Mars are all in the constellation Sagittarius, and so near the sun that at the opening of the month it is useless to look for them. Mercury, however, passes its inferior conjunction with the sun on the 6th, and thenceforth it will move rapidly out of the solar rays, arriving at its greatest western elongation and appearing as an early morning star at the end of the month. Mercury is in conjunction with Venus on the 10th and with Mars on the 13th.

It so happens that Mercury and the earth both arrive at their nearest point to the sun, perihelion, on this occasion nearly together, Mercury on the afternoon of the 1st and the earth on the morning of the 2d. But what a difference in the effect on the two planets! While we rejoice in a pleasing winter temperature, and our friends of the southern hemisphere in a summer glow not too ardent, the Mercurials, if any there be, have passed in the last six weeks from the frying pan into the fire. On November 18 their planet was only about four times as hot as the earth, but now it is ten times as hot!

Venus moves from Sagittarius into Capricornus in the course of the month, but Mars remains in Sagittarius, and neither will be far enough from the sun to be observed.

Neptune, invisible to the average naked eye, and hardly worth looking at even with a powerful telescope, is on the southern horn of Taurus, its position on January 1 being R. A. 5 h. 19 m. 25 s.; Dec. N. 21° 43' 40".

THE MOON AND ECLIPSES.

January opens with a waxing moon, the full phase occurring on the evening of the 7th, and the last quarter on the morning of the 15th. The first new moon of the year comes on the morning of the 23d.

There will be a partial eclipse of the moon, visible in eastern North America, on the evening of January 7, the middle of the eclipse occurring at 7:35 P. M. Eastern standard time.

On the 22d occurs a very important total eclipse of the sun, which will be invisible in this part of the world, but the line of totality, passing from Africa across the Indian Ocean into Asia, will be very well situated for observers in India. Well equipped expeditions from several of the leading nations of the globe have been sent to India, and astronomers eagerly anticipate results of the highest value and interest.

The Wellman Arctic Expedition.

Mr. Walter Wellman has bought at Tromso the sealer "Laura," a vessel of 153 tons, for the expedition which he will lead to Franz Josef Land next June. Nine men, chiefly Norwegians, will accompany him. Mr. Wellman's present purpose is to advance northward over the islands of Franz Josef Land as far as possible in the season of 1898. He intends to pitch his winter camp at the furthest point reached, and in the season of 1899 will make an attempt to reach the North Pole. Since the return of Dr. Nansen, the Franz Josef Land approach to the North Pole has not found much favor among authorities on Arctic exploration.

The Tombs of Voltaire and Rousseau.

A commission that was nominated by the Minister of Public Instruction and Worship, M. Rambaud, opened the tombs in the Pantheon at Paris, December 18, and settled the question of the whereabout of the ashes of Voltaire and Rousseau, which the late lamented Alphonse Daudet called the greatest mystery of the century. Both skeletons were found. Voltaire's skull had fallen into two pieces, which when placed together gave a striking presentment of his features. The skull of Rousseau showed no trace of a bullet wound, thus disproving the widely entertained belief that he committed suicide by shooting himself in the head.

THE TRADE SCHOOLS OF THE NEW YORK STATE REFORMATORY.

When an inmate enters the New York State Reformatory, he is given to understand that one of the chief conditions determining the time of his release will be his ability to earn his own livelihood. It is a mistake to consider this institution as one of the juvenile reformatories; the prisoners are not children, nor can the term boys, properly speaking, be applied to them. While the reformatory is a prison, it is a prison for adults who have been convicted and sentenced for offenses committed against the State. The committing age is between 16 and 30 years, and the average age of the inmates is about 21 years. It is a remarkable fact, which may be noted in passing, that more than sixty per cent of the prisoners in the State prisons, exclusive of the 1,400 or more prisoners in the New York State Reformatory, are not over 30 years of age. For the purposes of reformative treatment there is an elaborate system of classification. There are three character grades, with two subgrades, one for incorrigibles and the other for some who are believed to be completely cured of their criminality, but for some reason or other are still detained in service, frequently with pay. There are three intellectual grades, subdivided into twenty-eight classes for mental development and increase of common knowledge. Then, again, all the inmates are classified into trade classes, the selection being based on individual adaptation to various trades and the purpose being to fit the pupils for earning a livelihood after they leave the reformatory. The inmates are also divided into sixteen military companies, constituting four battalions and a regiment. A further classification is based upon the religious persuasion either of the prisoners themselves or their families. Still another classification is composed of those who are specially defective. In this there are three groups; the first including those who are exceptionally devoid of the mathematical faculty; the second of those grossly deficient in ordinary moral self-control; while group three is composed of dullards. Lastly, there is the physical training or renovation classification.

It has been found that one of the chief advantages of such a complete classification and treatment of prisoners for their reformation is that it involves, on the part of the authorities, a full and accurate knowledge of each individual inmate. The mere duty of assigning the prisoner to his proper grade and exercises assists in the study of him as an individual, while the constant observation and record of his progress supplies all the needed information regarding him. The regime of the institution is so laid out that from the hour of the early morning call until the retiring signal at night the minds and powers of the inmates are fully taxed and their energies directed in new and healthy channels.

The industrial status of the inmates on their admission to the reformatory shows the absolute need for industrial training, if they are to become useful or even tolerable members of the community after their release; for out of the fourteen hundred inmates in the reformatory, only twenty-four, or less than two per cent, knew any trade on their admission; seven per cent were capable of earning less than five dollars per week, and twenty per cent from eight to ten dollars per week. The trade school system now in vogue is the outgrowth of thirteen years of careful application of the industrial arts to the needs of the institution. It has long passed the experimental stage, and the industrial training now forms an integral part of the prison routine. The technological department undertakes to provide every prisoner with a trade, and for this purpose it is admirably equipped. Buildings have been erected for the specific use of the trade schools, classrooms are spacious and the various equipments are identical in size with those employed in the various industries. The exercises are carried out, not in miniature, but in full proportions, such as would take place in the actual competition of industrial life. The average trade course extends through twenty months, which is the average term of confinement in the reformatory. The prisoner is not given the privilege of selecting his trade, for it is considered that the authorities can make a better choice for him than he is capable of exercising for himself. Shortly after his arrival he undergoes an exhaustive examination before the general superintendent. He is catechetically examined as to the nature of the employment of his ancestors and relatives and as to his own tendencies. As a rule, the inmate does not express any choice. In other cases, where the granting of employment is vouched for by a manufacturer or business man friendly to the family, the particular vocation for which the inmate is to be thus prepared may determine the trade to which he will be assigned in the trade school.

In this system of compulsory education there are certain conditions which act as strong incentives to industry. When the novice arrives in the classrooms and finds about him two hundred fellow beings deeply intent upon their tasks, he catches more or less the prevailing spirit of animation and, without knowing it, follows the general example. As a matter of fact, it is rarely that an inmate does not take kindly to the work. Self-interest alone serves to impress even the crudest and most ignorant subject with the monetary value of the knowledge of a trade. But it will readily be understood that the most powerful motive to industry is the knowledge of the fact that the release from restraint depends very largely upon the advancement which is made in the trade schools. Another arrangement which conduces indirectly to the prisoner's progress is the practice of placing him at prison labor which, as far as possible, shall have a connection with, or supplement, his instruction in the trade schools. This rule is enforced by the administration with the greatest strictness; no foreman or officer about the institution is allowed to change the work or duties of an inmate, however humble they may be, without the sanction of the general superintendent. The welfare of the inmate is given the first place. It is never made secondary to the question as to how far his services can be made to bring the greatest pecuniary return to the State.

In conformity with this principle the members, for instance, of the brass-smithing class make and repair metal patterns for the use of one hundred moulders; machinists and blacksmiths perform in the hardware shop numerous hand and machine operations of fitting up castings as they come from the foundry and assembling them ready for the market. Clothing-cutting pupils again are kept occupied in the clothing industry. Manual instruction in the trade schools is supplemented by supplying the pupils with technical literature.

Trade journals form a considerable portion of the mail matter received at the reformatory and they are systematically distributed by the librarian, so that a tradesman receives a journal devoted to his individual craft. Moreover, the library contains a small collection of scientific and technical treatises and trade manuals which are furnished to the inmates upon application. The difficulty of instruction can be realized when it is known that in the case of a majority of inmates received there is an entire absence of any kind of wholesome training, not merely such as would give mechanical skill, but of anything which has called for application or concentration of thought. Observation and discriminating powers are lamentably wanting. The novices exhibit an astonishing ignorance of common things; the terms "straight," "square," "vertical" and "perpendicular" convey no well-defined meaning to their mind.

The average enrollment of pupils in the trade schools from October 1, 1895, to September 30, 1896, was 2,111. The excess of this over 1,810, which is the number of men confined for the same period, is accounted for by the fact that some inmates receive instructions in two trades. Of the 329 men paroled during the year 1896, 177, or 54 per cent, went directly to employment at trades acquired at the reformatory. It should be mentioned that in addition to their trade lessons the students in those branches in which a knowledge of draughting is helpful receive instruction in mechanical drawing. The drawing class was attended last year by 938 men, of whom 230 completed the course of study. The course in these classes is quite elementary, the aim being to give the students such instruction as will enable them to understand shop drawings.

As instances of the value of the instruction given in the trade schools we quote one or two cases taken from the records of the institution showing the employment procured after discharge. One case, a prisoner entered the reformatory October 27, 1894, who preceding his arrest had been a race-track bookmaker's clerk. He pursued in the trade school the courses of moulding and clothing-cutting. He was paroled February 10, 1896, and obtained a situation as a cutter at a salary of fifty-two dollars per month. Another case was that of a man who had been a bookkeeper and salesman at twenty-three dollars per week. While at the reformatory he took up bricklaying and plastering as a trade. After his release he went to work as a bricklayer, earning sixty dollars per month. It is claimed that the higher and nobler intellectual and moral effects of trade teaching upon the student are likewise distinctly traceable. Habits of thrift are inculcated, and with it a growing sense of, or a return of, self-respect.

The per capita per diem gross cost for maintenance of each inmate at the reformatory during 1896 was 0·428 cents, and the net cost or the cost to the State over inherent earnings and income, 0·363 cents per day. The gross outlay for the year was $212,556. The income was $32,281, so that the net cost to the State for the year was $180.274. We are indebted for the particulars of this article to Mr. Z. R. Brockway, general superintendent, and Mr. E. E. Clark, the director of the institution.

THE great vitality of dragon flies is shown, says The Independent, by McLachland, who having struck at a large æschna at rest on a twig, the head was seen to tumble down, while the rest of the insect flew away in an "undecided manner" for a considerable distance. Upon picking up the head he noticed that the insect had been eating a fly at the time. "The mandibles continued working as if nothing had happened, and the masticated portions of the fly passed out at the back of the head."

Science Notes.

Sweden is about to undertake the measurement of a degree of latitude within the Arctic circle. An expedition will be sent out in May to make a preliminary survey.

Ernest Giles, the Australian explorer, who between 1874 and 1876 twice traversed the West Australian desert from Adelaide to Perth and back, has just died. The Royal Geographical Society awarded him its Founder's Medal for his journey.

Science announces that the Austrian steamship Pola has gone to the Red Sea for scientific explorations, and will this year cover the ground between Dschedda and Aden. Dr. Franz Steindachner, the ichthyologist, has charge of the zoological work, and observations will also be made in physical oceanography.

M. G. Jacquemin states that plants which bear fragrant or sapid fruits, such as the apple, pear and raspberry, have also an aromatic principle in the leaves. If these are immersed in a saccharine fluid, together with saccharomyces or some other enzyme, the fluid will acquire both the flavor and the odor of the fruit, and the alcohol obtained by distillation from this fluid will possess the corresponding bouquet.—Comptes Rendus, cxxv, p. 114.

The lightest substance known is said to be the pith of the sunflower, with a specific gravity 0·028, while elder pith—hitherto recognized as the lightest substance—has a specific gravity of 0·09, reindeer's hair 0·1, and cork 0·24. For life-saving appliances at sea, cork, with a buoyancy of one to five, or reindeer's hair with one of one to ten, has been used, while the pith of the sunflower has a buoyancy of one to thirty-five.

Prof. Wollny, of Munich, Germany, has conducted some experiments to ascertain what was the influence earth worms had on vegetation. He found that their presence was extremely favorable, the produce of the several plants below being increased as follows: Pease gave 25 per cent more fruit, 35 per cent more stalks, etc.; beans gave 69 per cent more pease in the pod and 47 per cent more stalks, etc.; while potatoes yielded 136 per cent more. This favorable effect, says Prof. Wollny, is probably due to the ventilation of the earth by the holes dug by the worms.—Der Stein der Weisen.

A new scientific society has been formed in London that is to be devoted to matters relating to Roentgen radiation, and has been styled the Roentgen Society. The honor of being the first president of this new fraternity has been conferred upon Prof. Silvanus P. Thompson, whose work in this field has been particularly valuable. As a result of these investigations, Dr. Thompson has published a volume on "Light, Visible and Invisible." It is an elaboration of the series of lectures delivered by Dr. Thompson at the Royal Institution, at Christmas, 1896. To each reprinted lecture there is appended a useful series of notes and comments. "Roentgen Light" is the title of one of these lectures, which is naturally a synopsis of the views of the best authorities upon this phenomenon. The newly formed Roentgen Society will find plenty to do in studying the nature and action of these rays, says The Western Electrician.

The following note by Mr. Paul, of Cheshunt, in The Gardeners' Chronicle, October 23, 1897, on the method employed by M. Georges Truiffent of administering artificial food to plants, is of considerable interest to horticulturists. After an analysis of the ash of the living plant, the necessary salts for a given time, such as six months, are weighed out and inclosed in a metal cover to form what is called a "pill," which is presumably inserted in the pot, diffusion of the salts taking place through the folds of the metal, and the thicker the metal, the slower the diffusion. As the salts dissolve and disappear they are replaced by a core which expands until it completely fills the "pill." The salts have no action on the metal cover, which remains firm and hard. It is stated that the solubility of the salts can be so regulated that a "pill" may be made to last three or six months, as may be desired. By this method of feeding large well-colored plants are grown in pots of less than half the usual size.

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HYDROGRAPHIC SURVEYING—HOW THE MAPS AND CHARTS OF OUR COAST AND HARBORS ARE MADE.

BY THOMAS C. HARRIS.

If we were required to direct the course of a very large vehicle, filled with a costly burden of merchandise and precious lives, over a crooked and dangerous road, bounded everywhere by hidden perils, we should consider our responsibility as very grave and the occupation as specially perilous. Such is the occupation and responsibility of the ship captain, for his vehicle is a costly vessel and its freight often worth millions, while the road he travels is frequently very intricate, and a slight error in his course may involve a total loss of all on board.

Just before entering a harbor, the captain usually signals for a pilot, who will go aboard and assume control of the wheel. He will direct the course of the ship along channels of the deepest water so that she may not run aground. These channels are often very narrow and crooked, turning about in the most unexpected and unaccountable way, but all their turnings are as familiar to the intelligent pilot as the walks about his house or the position of his furniture in his bedroom. He knows them by constant goings to and fro and frequently sounds or measures the depth at various places, in order to ascertain what sort of change may be taking place.

It seems very odd to the landsman, as he stands beside the pilot, to see him turn the course of the vessel, this way or that, when there appears to be miles of open water before him and he might seemingly steer anywhere. He does not realize, at first, that the pilot is following the familiar though hidden paths and thereby avoiding the dangerous rocks or shoals.

To accurately survey and make maps of the coast line and harbors of our country, and thus enable all to understand their hidden dangers, is the work of the United States Engineers and the Coast Survey Department. The methods they use are scientific and interesting. The principles of such work are simple and easily comprehended, though the reader may have no knowledge of surveying.

It is an easy matter to measure the dimensions of a plot of ground, the size and location of the buildings or other objects that may be on it, but on the water a different process must be pursued. Not only is it necessary to map the shore line and all the visible topography near it, but the depth of the water and character of the bottom must be minutely shown. When such a map is properly drawn it forms a very interesting picture of that locality. A map of this sort is usually called a chart.

The careful study of a fine chart produces just such an impression on the eye and mind as if we could look down on the scene from a balloon. We see all the houses, hills, rocks and trees of the shore and every undulation of the mud and sand on the bottom, with the water removed. Many miles of coast and harbor may thus be shown on one sheet of moderate size, with everything in its proper proportion, shape and position.

To the ship captain the depth of the water and location of the dangerous places are all important, for the safety of his vessel and cargo, with perhaps many lives, depends on escaping the numerous dangers hidden beneath the waves.

The depth of water is ascertained by a sounding rod or pole, thrust down from a boat, or by means of a lead line which is lowered by hand until the lead touches the bottom. These measurements, or soundings, as they are usually called, are done at regular intervals of distance and on known lines or courses over which the sounding boat is steered. The depth of water at each sounding is noted in the sounding book, as well as the hour and minute of the day.

For each sounding made it is necessary to know the exact spot on the water that the boat occupied at that particular moment, and this is done by a process known as triangulation. One way of doing this is by observers stationed on the shore at two or more prominent places, and always in full view of the boat. Each observer follows the course of the sounding boat with the telescope of his transit.

For the benefit of those of our readers who may not be familiar with surveying instruments, we would say that a transit is an instrument having a telescope so attached to a graduated circle that its exact amount of rotation around its pivot may be noted. Consequently, the angle formed by the position of the boat, the transit station and some fixed object on the shore may be very accurately and quickly determined, even to the small fraction of a degree.

In a circle there are 360 degrees, each of which is supposed to be divided into 60 minutes, and each minute into as many seconds. Since a degree on the circle of the transit occupies a space of a pin's head, it is, of course, impossible to subdivide each degree into minutes and seconds, but these small spaces are easily read by an attachment called a vernier. To many persons it will seem too trifling to take notice of so small a space as the minute of a degree, but that much of an angle grows to become a considerable distance if the line be prolonged four or five miles.

Each transit operator takes an angle on the boat at every sounding, noting in his book both the angle and the time it was observed. The rodman on the boat may take the depth every fifteen seconds of time, waving a small flag as he does so, while the recorder on the boat notes the depth and time of each sounding. All the recorders, while working, use watches which are adjusted to keep time together.

When the chart is made we have first an accurate survey of the shore lines, base lines, transit stations, houses, etc., done in the ordinary way. The water will at first appear as so much blank paper. By referring to the diagram, it will be seen that the two transit stations are more than a mile apart and on opposite sides of the mouth

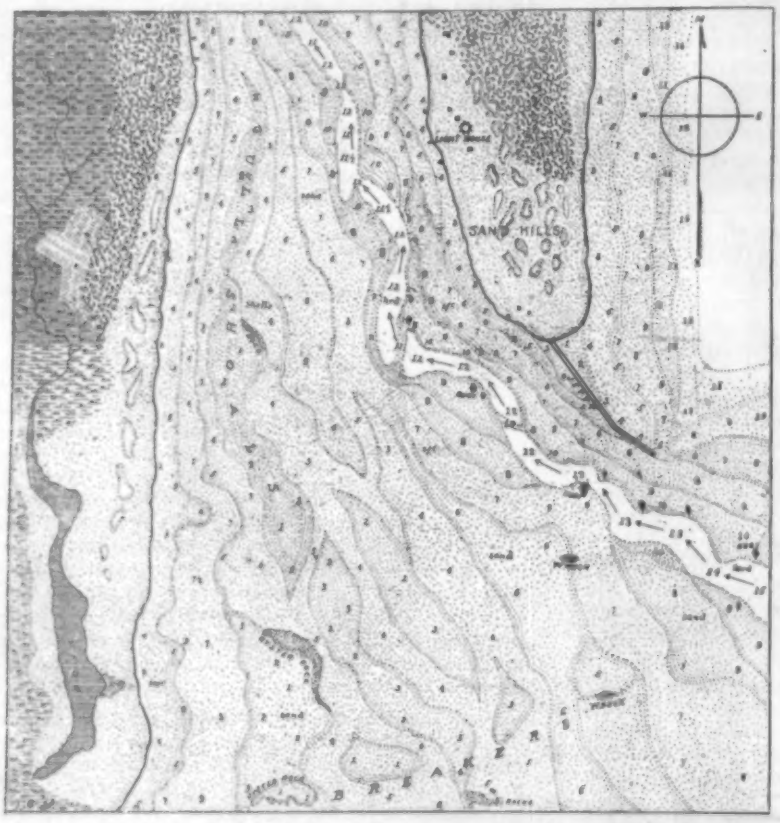
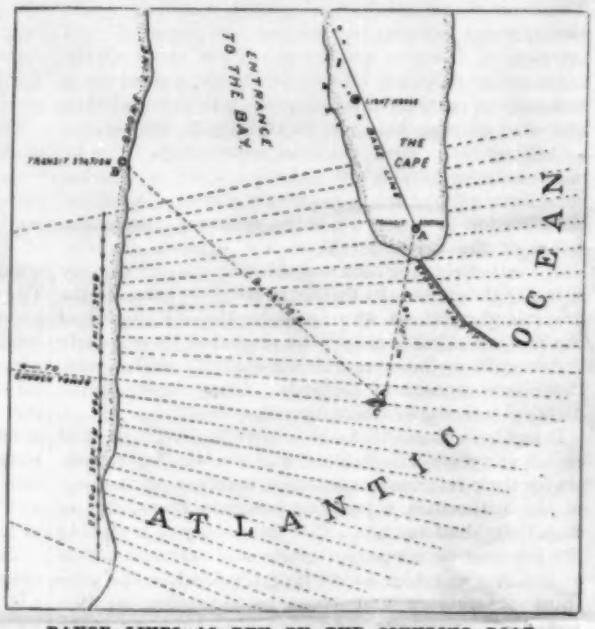
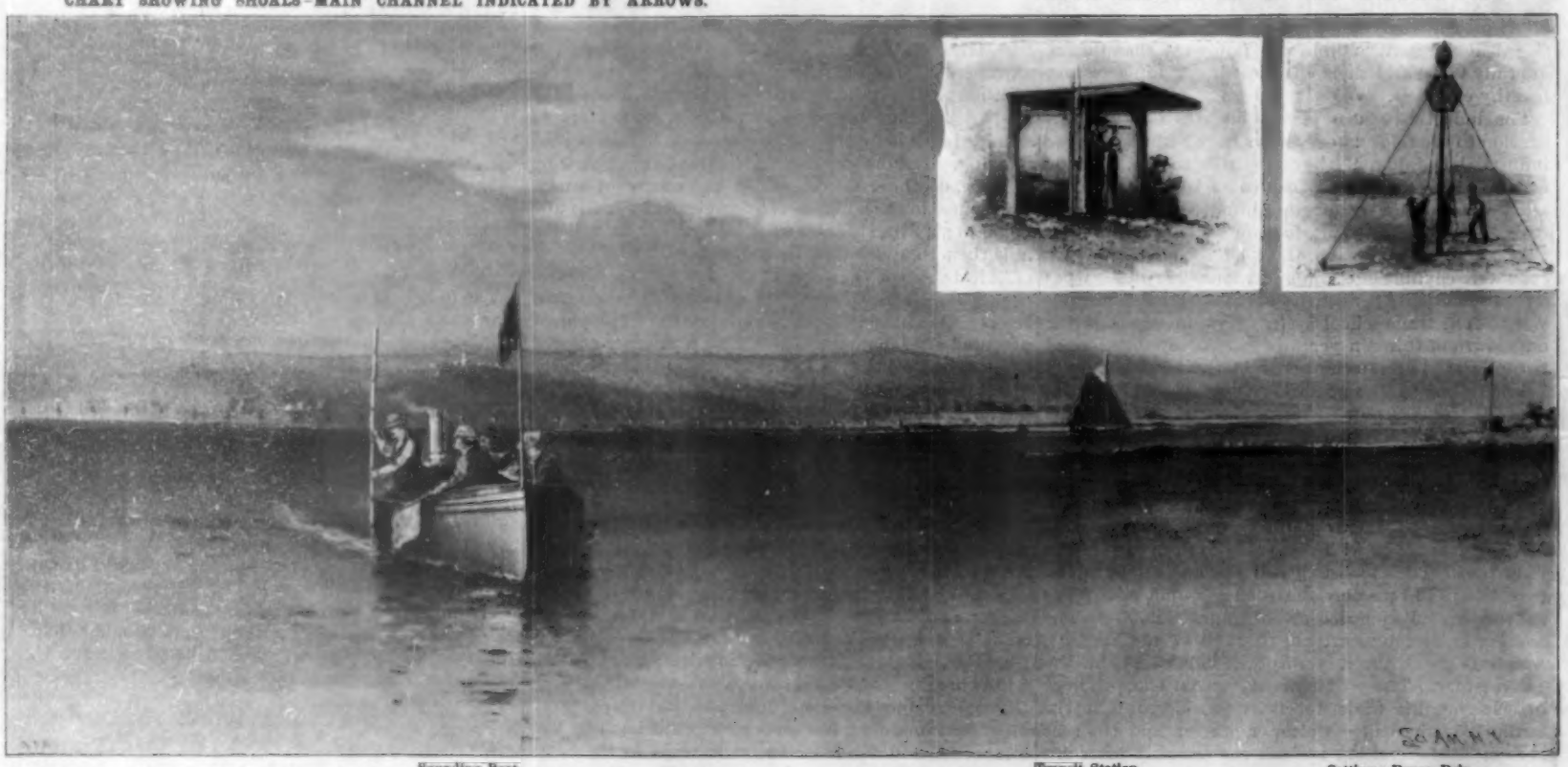


CHART SHOWING SHOALS—MAIN CHANNEL INDICATED BY ARROWS.



RANGE LINES AS RUN BY THE SOUNDING BOAT.



Sounding Boat. Transit Station. Setting a Range Pole.

HYDROGRAPHIC SURVEYING.

of a bay or river. The dotted lines show the proposed ranges or courses of the sounding boat. In going back and forth over the space to be sounded, the boat is steered in straight lines by the aid of signal poles and targets, previously set up on shore, at regular distances apart. This is very important, for it enables the boat to be steered over the entire space, in regular lines, and thus makes sure that no considerable area be omitted. On the main land and some miles to the westward is a church tower, visible for many miles at sea. On his outward run, or in returning toward the shore, the pilot so steers the sounding boat as to keep one of the target poles in a line with the church tower, and thus insures a straight course.

To locate each sounding at its proper place on the chart, the following process is carried out: The sounding book may show that a depth taken and recorded at 10:45 o'clock was 10·5 feet. Transit book A may show that the angle or position of the boat at that hour and minute was south 9 degrees and 15 minutes west. Transit book B shows the angle from station B at that time was south 42 degrees and 10 minutes east. If these two courses or angles be now traced on the chart, from stations A and B, the lines will intersect at C, which was the true position of the boat. We make a dot there, and set down 10½ feet.

This way of locating a distant object, by the measurement of angles, is remarkably rapid and exact. The boat may be four or five miles from the shore, yet its true position may be laid down on the chart as exactly as if it were possible to walk out to it and measure the distance with a chain. The boat need not stop at all, but usually proceeds at a slow speed, taking soundings at the rate of four every minute or 240 per hour. To follow the course of the boat with the transit, reading and recording every angle and the time, will keep two men at each station very busy indeed. They will scarcely have enough spare time to brush away a mosquito.

In an ordinary harbor, many thousand soundings are taken, and they are all entered on their proper place on the chart, showing the depth of water everywhere. In this condition the chart will have its water area covered with figures, about as close as they can be written. The contour lines are now drawn, connecting spots of nearly equal depth. They represent the edges or outlines of areas of bottom of that average depth of water, and they curve about in the most unaccountable way. Spaces of equal depth are colored or shaded by a system of fine dots, and so outline the reefs and shoals. The character of the bottom will be indicated by the words sand, shells, rocks, mud, hard, soft or sticky. Specially dangerous places are marked by buoys as well as the main ship channel. The channel buoys are of a standard shape and color, and mark the way as plainly as the signboards on the country roads. Indeed, they are the only signboards the sailor has, unless he is very familiar with that locality. The professional pilots get so familiar with their harbor that they seem to develop a special sense, and readily find their way on the darkest nights.

Shoals are composed mainly of sand, and are creatures of the current. These drifting particles are carried along by the moving water, but settle to the bottom as soon as the flow becomes too slow to keep them in motion. Therefore, if anything should cause a variation in the current by diverting its usual course or increasing its speed, the drift material of the bottom begins to be cut away and moved along by it, forming an addition to some shoal further along or building up an entirely new one. Where a river empties into the sea, its outlet is usually much broader than the stream higher up; hence the volume of water flowing through the wider outlet has its speed of flow much reduced. This causes the particles of drifting sand and mud to settle to the bottom, and results in the formation of a bar or line of shoals, partially closing the outlet. They sometimes form islands or delta, as at the mouths of the Nile and the Mississippi.

At some places it has been found practicable to make the current carve out its own channel by diverting its course or narrowing its bed. This is usually done by jetties, which are artificial barriers, usually of stone work, to increase the speed of the current at that place. In such cases the drift matter is transported by the water further out into deep water, where it will be out of the way.

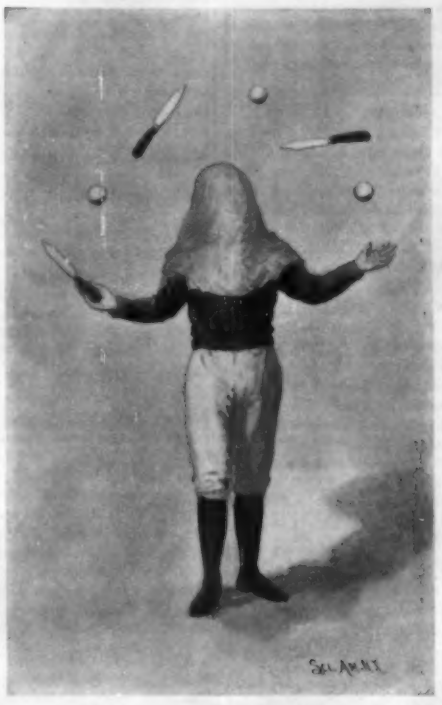
It is said that all the characteristic features of the country, constituting what we call scenery, are the result of erosion. The action of the rain, snow and frost serves to carve into other forms the surface of the earth, and may result in the total change of the appearance of a place within a century or less. The erosion of the bottom of all flowing streams takes place much more rapidly. The shoals are liable to shift their position without any apparent cause, making frequent surveys necessary, so that these aids to navigation may be kept up to date.

Without such careful work as is done in our waterways by the government engineers, the vocation of those who have occasion to go in or out of our harbors would be perilous indeed.

THE BLINDFOLDED JUGGLER.

BY W. B. CAULK.

While watching the clever manner in which a good



THE BLINDFOLDED JUGGLER.

juggler passes various articles from hand to hand, how many people ever give a thought to the many hours of practice devoted to even the simplest trick that he performs? To become even a passable juggler, many weary months of constant practice are necessary. There are tricks in all trades, and some of the most successful entertainers in this line can scarcely do a half dozen genuine feats of juggling, yet they are great favorites with the public. It has been truly said that "the tricks that require the most practice are the least appreciated by the average spectator." It is my intention merely to show how a simple trick has won fame for several well known jugglers.

This is the trick of juggling blindfolded. An assistant tightly binds a heavy handkerchief over the juggler's eyes, and then, to make sure that he cannot see, there is placed over his head and shoulders a sort of bag, made of heavy goods, which should exclude all light, even if his eyes were not tightly bound with the handkerchief. Regardless of this, the juggler performs the usual passes with balls and knives. Yet, when the bag is removed, the bandage over his eyes is found undisturbed.

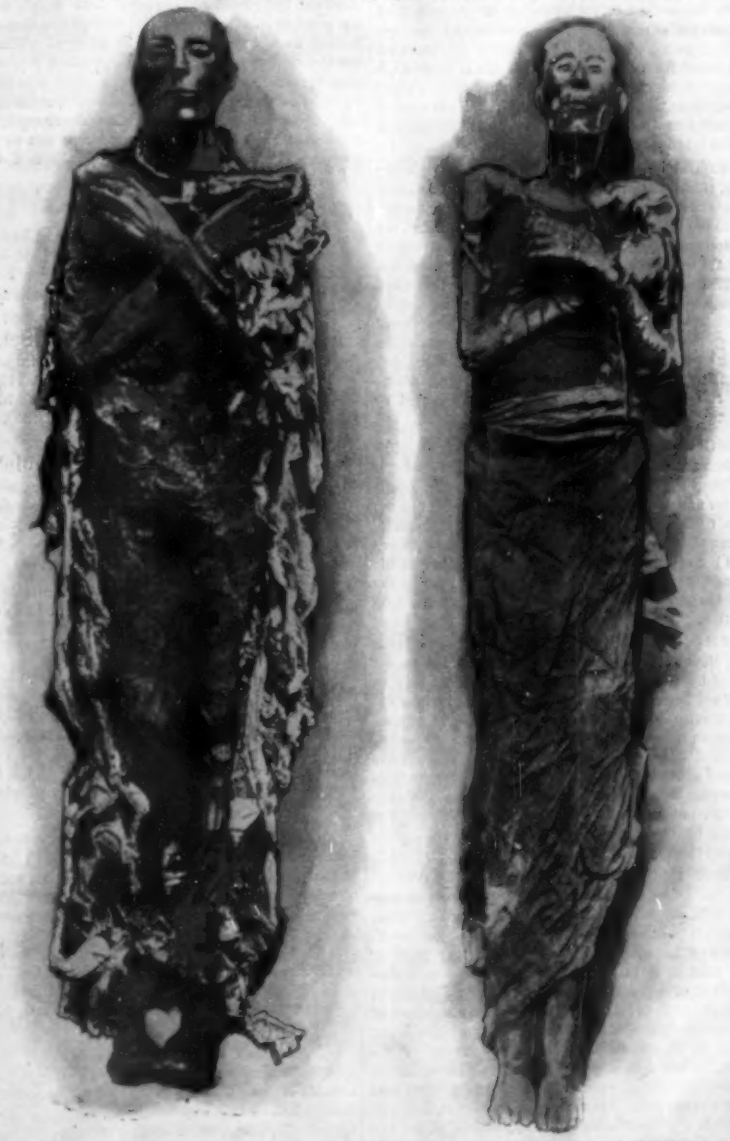
This is most simple. The bag is made of the usual coarse bagging, and a few threads are pulled out of the part that will come in front of the juggler's face when the bag is over his head, thus allowing him to see between the remaining threads as though looking through a coarse screen.

When the bag is being placed over his head, and during the seeming effort of passing the arms through the armholes in the bag, the performer or assistant has no trouble in pushing the handkerchief up from the eyes to the forehead, thus allowing him to see through the open work of the bag. In removing the bag after the act there is no trouble in pulling the handkerchief down over the eyes.

THE ILLUSION EXPLAINED.

RAMESES THE GREAT.

Of course nothing is easier than to talk cheap platitudes before the spectacle of a monarch's corpse, and not a few writers have made capital of a sort by contrasting the history of Rameses II. with those mummied bones of him now lying in the Gizeh Museum. For my part, says Mr. Eden Phillpotts, in Black and White, these human remains of famous Pharaohs caused me some indignation thus seen exposed behind panes of glass. Why, because a great one happens to have perished some few thousands of years, should we desecrate his dust in this fashion, and treat it as a peep show? And great beyond question was Rameses II—a man of genius, the first ruler of his time, one who at ten years of age sat in the state councils of his father at Thebes, who reigned at twelve years old, who at seventeen led conquering armies against the warlike Lybians. "Thou wast a ruler of this land when thou wast still in the egg," declares the famous inscription on the walls of the Medinet Habon temple. "Thou didst act with wisdom, didst speak even in childhood for the land's weal." At an age when our young men are just passing to the universities, into the services, or through some other portal leading to life's battle, the second Rameses had made his power felt throughout ancient Egypt and the civilized world. He filled the throne for sixty-seven years, passing as an old man of about eighty from the scene of his remarkable life. His works were manifold. The Egypt of his day won a thousand industrial advantages from his energy and foresight. He built great treasure cities, developed the canal system, improved agriculture, advanced his nation's welfare, extended her borders, and loomed a colossal power through nearly three generations of mankind. His name was whispered next to the gods of the land. He appeared no less than a manifestation of deity to the masses. That he had many faults is certain, in that he was a man; but there can be no shadow of doubt that the soul of one of the giants of earth inhabited the small frame of Rameses the Great, and thirteen hundred years and more before the beginning of the Christian era his was certainly the greatest name on earth. To-day his ashes lie in a glass case, and for a few piasters any eye may behold them. In the hall of the royal mummies at the Gizeh Museum do "the dead lift up their voices and tell the tale of their whole life," to quote words of Renan. Here lie the bodies unearthed at Thebes in 1881 by Mariette Bey, and the collection includes a king and queen of the 17th dynasty, five kings and four queens of the 18th dynasty and three successive monarchs of the 19th, these last being Rameses the Great, his father Seti I, and his grandfather. The 20th dynasty has no representative, but belonging to the 21st are two kings, four queens, princes, a princess, and sundry priests.



SETI I. AND HIS SON RAMESES II., GIZEH MUSEUM.

RECENTLY PATENTED INVENTIONS.

Engineering.

ROTARY ENGINE.—Riley D. Fassett, Harris, Mo. Extending transversely through a cylinder, and having bearings in its side walls, according to this invention, is a driving shaft upon which two circular piston disks are eccentrically mounted, the disks being reversed as to their eccentricity, and mounted on the shaft between the disks is a partition block bearing at its periphery closely against the inner surface of the cylinder. Extending entirely across the cylinder is a housing having steam chambers divided by a partition, and moving vertically in the housing are abutments engaging with the piston disks, the abutments having at their opposite sides depressions forming steam ways. A slide valve controls the ports, and there is an expansion regulating valve, a lever having connection with both valves.

Railway Appliances.

CABLE GRIP.—Joseph S. Peden, New York City. This improvement affords a guide which will loosely hold the cable while the car carrying the grip is rounding a curve, thereby preventing the cable from leaving the jaws of the grip and holding it in such position that the jaws may clamp the cable the moment the curve is passed. This guide attachment may be applied to any form of grip, enabling the cars to round the most abrupt curves as slowly as may be desired, the cable being released at one end of the curve and taken up at the opposite end.

RAILWAY CATTLE GUARD.—Albert A. Graham, Topeka, Kansas. To more effectually exclude cattle and other animals from railway tracks this invention provides a novel form of metallic pivoted jaws or blades to be arranged longitudinally between and at the sides of the rails, there being on these blades long and sharp teeth preventing an animal from making a step against them, but not liable to inflict permanent injury. The improvement affords a guard against live stock of all sizes and kinds, does not need a pit to break the continuity of the track, and has no projecting points on which dragging chains, rods, etc., may catch.

Bicycles, Etc.

LUGGAGE CARRIER FOR BICYCLES.—Harold J. M. Baker, Port Townsend, Washington. This is a device formed of spring wire or metal strip into three principal bends or loops, adapted to be attached to the handle bar of the machine. It is simple, inexpensive, small and compact, readily attached to or detached from the machine, and may be conveniently carried in the coat pocket.

POLYGONAL TWO-PIECE CRANK.—Frederick C. Avery, Toledo, Ohio. According to this invention the bicycle shaft and crank have reduced and oppositely tapered polygonal tenons, and the motor wheel has a bore adapted to fit such tenons when lapped, while a nut engaging the wheel causes it to hold the tenons in unyielding contact. The sprocket wheel hub and shaft are thereby firmly and rigidly connected, and yet may be readily detached. It is simple, neat, light, strong and inexpensive, and has been already thoroughly tested on over 7,000 bicycles. It has every appearance of being continuous from end to end, there being no unsightly bolt or screw heads sticking out. This improved crank is manufactured by the Chicago Bicycle Specialty Company, Chicago.

BICYCLE DRIVING GEAR.—Jesse E. Stoops, Dayton, Washington. A gear adapted to be operated by hand, and that is auxiliary to and for use in connection with the ordinary pedal driving gear, is provided by this invention, the two mechanisms being so arranged that they may be operated together or either gear operated independent of the other. This gear may be applied to any form of frame with slight alterations or additions, and the arrangement is such that the entire weight of the body, together with all the power exerted in the lifting operation of the hand-driving mechanism, will be communicated to the driving mechanism operated by the feet.

THREE-WHEELED CYCLE.—Theophilus E. Montgomery, Wilmington, Del. This cycle has a central driving wheel, and smaller forward and rear wheels, arranged tandem, and the frame pivoting is such that the jar is distributed throughout the parts and reduced before reaching the saddle, making the wheel easier to ride than the ordinary bicycle. Either the forward or rear wheel may be used for steering, and the cycle is capable of turning as short and being as easily handled as previous forms of construction. Ordinary forms of driving mechanism are employed.

Mechanical.

BRAKE FOR HORSE POWER MACHINES.—Thomas P. Chambers, Newtown, Pa. To prevent the tread floor of such machines from traveling too fast for the animals operating them, or for stopping the movement entirely, this inventor has devised a strong, simple and inexpensive brake, located between the stretches of the floor, and having brake bars adapted to be brought into engagement with the lower rollers of the tread floor upon the movement of a lever. The housing for the animal, as well as the tread floor, may be of any desired construction, and the mechanism may be applied to any form of horse power machine.

PLATE LIFTER.—Elam D. Diffenderfer, West Milton, Pa. To facilitate getting a secure hold on a plate, pan or other vessel, to place it in different position or transfer it from one place to another, this lifter comprises a handled rod with transverse slot at its forward end and a longitudinal groove, there being secured in the slot a doubled up metal flange with eyes in which are secured the ends of an outer jaw, while a sleeve sliding on the rod has a tongue engaging its groove, the sleeve having in its side eyes in which are secured the ends of an inner jaw, there being means for holding the sleeve in a forward position to lock the inner jaw in position on the plate.

Agricultural.

CORN HARVESTER.—Frank Hixson, Ashland, Ohio. This invention provides a simple, strong and inexpensive harvester upon which the cornstalks as cut may be piled to form a shock of the desired size, the shock being then deposited on the ground in upright position. Combined with a platform carrying knives is a platform which turns and is provided with uprights, supporting bars being removably carried by the revoluble platform, and binding devices being carried by the supporting bars, while a lift lever is provided with pendent members adapted to engage with keepers on one of the supporting bars.

ANIMAL STALL.—William M. Underhill, Underhill, Wis. A stall of simple and inexpensive construction, designed to facilitate keeping clean a barn or stable, is provided by this invention, there being at the rear portion of the stall a chute board mounted to swing, and adapted to stand in inclined position, to receive the droppings and convey them outside the stall. Provision is also made whereby the confined animals may be conveniently fed, attended or liberated in case of fire, the construction, combination and arrangement of parts affording important advantages over constructions hitherto employed.

CROSS CLEVIS.—John L. Thomas, Osceola, Mo. A device readily applicable to a three-horse plow having a beam brace, or to any other kind of plow, is provided by this invention. A clevis pin is removably held on the clevis body, an arm adjustably held on the clevis body forming a bearing for the free end of the pin, while a cotter pin extends through the arm and engages one of a series of recesses in the inner edge of the clevis body to lock the arm in place on the body.

SIEVE FOR THRASHING MACHINES.—Henry Foecke, Crofton, Neb. A screen capable of universal adjustment has been devised by this inventor, whereby a proper relation may be maintained between the caliber of the screen and the amount of grain being handled. A number of parallel bars are rigidly held by a frame, plates being hung pendent from the bars, while rods which run transversely to the bars may be held at any desired proximity to the frame, causing various positions of the plates to give the sieve a large or small caliber, the adjustment being made to suit the amount of grain to be taken from the straw.

Miscellaneous.

SEXTANT.—Frederick J. B. Cordeiro, United States Navy. According to this invention, the frame has a graduated arc and a telescope or its equivalent for direct observation, while an index arm pivoted at one end to the frame is adapted to swing between the frame and telescope, the index arm having near its pivot a rigidly secured isosceles prism, the end surface of the prism bisecting approximately the field of the telescope, and the axis of the prism being parallel to the pivot of the index arm. The sextant is designed to facilitate observation by rendering the image observed by indirect observation brighter and more distinct than that obtained with the usual arrangement, the arrangement being more simple, the horizon glass being omitted, the instrument having no parallax, and the adjustment being easier.

MEASURING POLE.—Reuben Hegarty, Madera, Pa. In poles or rods which are extensible longitudinally, this invention provides an improvement whereby the sections or members are so connected as to be adapted to slide one on another and have no projecting parts. The sliding members are provided with a detent for holding them immovable at intervals, a thumb screw passing through one of the members being adapted to engage the other member, and the head of the thumb screw being situated in a recess in the member to which it is secured.

WEIGHING SCALE.—Elmer A. Terpening, Geneseo, Ill. A scale more especially designed for weighing ice, cotton bales and other merchandise while in motion, has been devised by this inventor, the invention consisting principally of a pulley adapted to be rotated from the weighing beams, a clutch mechanism for actuating the tally or registering device and adapted to engage the pulley, and a tripping device controlled by the merchandise for throwing the clutch mechanism out of engagement with the pulley. The merchandise passing over the platform is weighed and the mechanism is reset as the weight leaves the platform, the machine being self-adjusting or balancing and not affected by any accumulation of dirt or pieces of merchandise.

ZINC AND ZINKIFEROUS ORES.—Edgar A. Ashcroft, Grays, England. To prepare zinc ores and zinkiferous lead ores for smelting, this invention provides for first converting the zinc sulphide present in the ore to neutral or basic zinc sulphate and zinc oxide, grinding the ore, and then leaching the finely ground ore with a hot solution of ferric sulphate to dissolve out the zinc and precipitate the iron as ferric hydrate in the residue to serve as a flux in the subsequent smelting operation.

DUMPING APPARATUS.—James G. Delaney, New York City. This invention provides an apparatus by which a load receptacle or bucket may be raised and lowered, or conveyed and dumped where desired, the apparatus being suitable for use in various ways, with transfer or cable systems or with a derrick. Combined with a frame and winding drum is a sheave mounted adjacent to the drum, the sheave being capable of carrying a cable and being freely movable in each direction independent of the drum, while the latter is capable of connection directly with the cable, to be operated thereby.

FIRE PLUG.—Edgar C. Wiley, Lynchburg, Va. This device comprises a casing below the stand pipe, the latter fitting within the casing and being clamped in position without any lateral projections to afford a surface against which the earth may press in such manner as to lift the plug. The casing is also slightly tapered inward from a point below its middle to its upper end to avoid any lifting by the upwelling of the ground. The arrangement renders the vent outlet certain in its operation, permits the draining of the stand pipe down to a point but a short distance above the plug valve, and furnishes both the plug valve seat and the vent outlet valve seat in the same part, facilitating both the manufacture and application of the improved plug valve.

BALE TIE.—Thomas C. Edmonston, Houston, Texas. This tie has a locking plate with aperture near each end, longitudinal grooves running into one of the apertures and diametrically opposed on opposite faces of the plate, there being a bayonet slot in one of its sides and an angular slot on the opposite side. A wire having one end extended through the grooved aperture is bent or doubled back through the other aperture, the other end of the wire being bent through the slots and transversely around the plate, forming a loop engaging the doubled up part of the wire. The tie is not liable to become accidentally unlocked, and may be used on ordinary compresses.

FOLDING DISPLAY RACK AND TRAY.—James S. Baird, Golden, Col. This device comprises two end frames, each composed of a series of bars pivoted together to form a lazy tongs, the end frames being connected by bars which form common pivots for the centers of the side bars and being provided with a lifting handle controlling the locking mechanism. The trays for the goods are fastened on the common pivot bars and the outer ends of the side frames. Racks or shelves of any kind may be substituted for the trays, and the device is readily foldable into small space.

INVALID'S BED.—Stephen C. Attkisson, Salem, Ind. This invention provides an improvement adapted for use in connection with an ordinary bedstead, comprising a rectangular frame nearly equal to the length and width of the bed, in the bottom of which is a canvas sheet, forming the bottom of the invalid's bed. The frame is adapted to be raised and lowered from and to the bed proper by means of a line attached to a winding drum on a stand, and a block and fall connected with the ceiling, the invalid being thus moved without disturbing his comfort or causing exposure to uneven temperatures.

SASH LOCK.—John N. Ahrens, Union, N. J. This device is designed to facilitate holding sashes open to a certain extent and prevent their being forced further open. The upper sash carries on its side bar a ratchet plate, and fixed on the upper side portion of the lower sash is an angle plate on which are two slightly flexible standards carrying a thumb screw on which swings a pawl, the standards being adapted to clamp the pawl and hold it rigidly in position. Pivoted between the standards is a spring-pressed link carrying at its outer end a shoe adapted to engage the ratchet plate, the thumb screw and pawl holding the shoe firmly in such engagement.

DOOR FASTENER.—August H. Wesling, St. Louis, Mo. Combined with a spring-controlled bolt with which is connected a rod, is an angle lever connected at one end to the rod, a main lever being pivoted to the other end of the angle lever, and there being guide pins on each side, the main lever having an edge recess adapted to receive one of the guide pins when raised, while there are operating connections from the door knob to the main lever. The device is adapted for attachment to any door, serving to fasten the door to the floor at any point in its travel, preventing the closing or farther opening of the door by the wind or a draught.

CONDIMENT BOX.—Adolph Jenatschke and Ernst C. Fischer, New York City. This is a combined salt and pepper box, arranged with simple means for grinding the pepper to the desired fineness while holding the box over the food to be seasoned. The box has two independent receptacles mounted to rotate one upon the other, a ring carried by one receptacle having an interior grinding surface flared outward, and a grinding cone carried by the other receptacle engaging the grinding ring. The ground pepper drops out as it is ground, and the device is inverted to sprinkle salt.

Designs.

FRAME FOR PRESCRIPTION CABINET.—Joseph M. Worthington, Annapolis, Md. This design affords a flat intermediate table portion over a central cupboardlike section, and upright sections at each side of the central table portion.

JAR FASTENING BAR.—John Schies, Anderson, Ind. This design is for a spring wire or rod bent somewhat S-shaped on top and with short hooklike end sections, to be sprung into engagement with the top of a jar cover and the bead at the edge of the top of the jar.

PLAITED FABRIC.—Paul Gumbinner, New York City. This fabric has on its obverse side intersecting fluted panels and on the reverse side similar panels with a longitudinal rib where the panels join, the fabric having scalloped upper and lower edges.

GAME BOARD.—Dallas Du Bois, Montclair, N. J. This board has a central turntable with marginal pockets, and partitions of checkered formation radiating from the space in which the turntable is placed.

CARD CASE ATTACHMENT.—William P. Ordway, Boston, Mass. This design affords a novel form of spring wire holder to be used in connection with a card case in the game of duplicate whist, and provides for the holding and keeping separate of the several hands in the game, likewise providing for the ready removal from or introduction into the case of any particular hand.

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NEW BOOKS, ETC.

THE ELEMENTS OF ELECTRIC LIGHTING. By Philip Atkinson, A.M., Ph.D. New York: D. Van Nostrand Company. Pp. 279. Price $1.50.

Dr. Atkinson's treatise, first published in 1888, has now, revised and enlarged, reached its ninth edition. It treats of electric generation, measurement, storage and distribution. In the last edition descriptions are given of the later dynamos of the multipolar type, new kinds of storage batteries, and a brief account of vacuum tube lighting. The book is designed not only to interest and instruct the general reader, but also to serve as a convenient hand book for the electrical engineer.

CURIOUS HOMES AND THEIR TENANTS. By James Carter Beard. New York: D. Appleton & Company. Pp. 275. Price, 65 cents.

This, the latest in the series of Appleton's Home Reading Books, is designed, as have been its predecessors, to supplement the school studies of young people, and make interesting and attractive at the fireside subjects which have been, perhaps, too formally presented at school. The "homes" here described are in the earth, rocks, trees, grass, snow, water, etc. The author has succeeded in presenting his subject in most entertaining style, and the publishers make of it an attractive volume.

A TEXT BOOK ON APPLIED MECHANICS. Vol. II. By Andrew Jamieson. Philadelphia: J. B. Lippincott Company. London: Charles Griffin & Company, Limited. Pp. 388. Price $2.50.

A text book is here specially arranged for advanced students in applied mechanics, the author having previously furnished text books on steam and steam engines, elementary applied mechanics, magnetism and electricity, etc. The volume comprises a series of lectures on Motion and Energy, Graphic Statics, Strength of Materials, Hydraulics and Hydraulic Machinery, and contains numerous diagrams and examination questions.

THE PRACTICAL ENGINEER'S POCKET BOOK FOR 1898. Manchester, Eng.: The Technical Publishing Company. Pp. 374. Price 75 cents.

This is the ninth annual edition of a pocket book and diary which has proved very popular among engineers and mechanics, as affording a convenient and very full reference book and mentor in many of the questions ordinarily coming up in daily practice.

TUTORIAL TRIGONOMETRY. (Of the Cambridge [English] University Tutorial Series.) By William Briggs, M.A., F.C.S., F.R.A.S., and G. H. Bryan, Sc.D., F.R.S. London: W. B. Clive. Pp. 326. Price $1.

This is a strictly technical text book of the University Correspondence College Press, and as such ranks as an undoubted authority, with the subject matter arranged, in connection with comparatively simple questions, in such manner as judged best to facilitate the study by students.

PRACTICAL WOOD CARVING. A simple treatise on the rudiments of wood carving. By Charles J. Woodsend. Illustrated by numerous engravings of original drawings. New York: David Williams Company. 1897. Pp. 86, 108 illustrations. Price $1.

This book treats of the proper method of handling tools as well as the shape for grinding them in order to produce different kinds of work. Special attention is given to the transferring of designs upon the wood. There have been a number of books devoted to this subject and we do not remember of any in which the illustrations have been so clear. The diagrams of advanced carving, as the Corinthian columns, are particularly noteworthy. The book will prove of value not only to the beginner, but also to those who are already proficient in the interesting art of wood carving.

DIE ELEKTRISCHEN BELEUCHTUNGS-ANLAGEN. Dr. Alfred Ritter von Urbanitzky. Leipzig, Vienna: A. Hartleben. 1898. Pp. 240, 113 illustrations. Price 75 cents.

This book shows what can be done in the way of making low cost books on electricity, in which the scientific value is not sacrificed to the popular desire for a subject reduced to its lowest terms. The author published an excellent work several years ago entitled "Electricity in the Service of Man."

A TEXT BOOK OF GENERAL BOTANY. By Carlton C. Curtis, A.M., Ph.D. London and New York: Longmans, Green & Company. Pp. 350. Price $3.

The author, a tutor in botany in Columbia University, bases the text of this volume upon the laboratory work required of beginners at Columbia, of which it is an exposition supplemented by a course of lectures and prescribed reading. The laboratory work requires two mornings a week during the year, and the illustrations are mainly from laboratory material gathered from the students during the past two years.

THE ESSENTIALS OF GEARING. A text book for technical students and for self-instruction. By Gardner C. Anthony, A.M. Boston: D. C. Heath & Company. Pp. 84. Price $1.50.

The professor of drawing in Tufts College, in this publication, adds another volume to his technical drawing series, and one intended both as a reference book and as a text book. The book has many folding plates, and is designed to furnish a working knowledge of the theory of gear teeth curves by a graphic solution of problems relating thereto, suggesting also lines of thought and study beyond these limits.

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(7290) H. M. S. writes: Will you please give me some information in reference to dynamos, which I do not see my way clear in? What difference is there in a bipolar and a multipolar and a 6 pole dynamo? Do the multipolar and a 6 pole dynamo give better results than bipolars? This is a question I do not quite understand. Have the brushes on 4 and 6 poles anything to do with it? A. Bipolar and multipolar are words which refer to the number of pole pieces in the field of a dynamo or motor. The current in an armature coil is reversed every time the coil passes a pole. In a multipolar machine there are more reversals for each revolution of the armature, and to secure a certain number of alternations per second, the speed of the armature may be less as the number of poles is greater. A 6 pole dynamo is a multipolar dynamo. The name does not refer at all to the current the machine gives. You would learn far more by applying to the engineer of some electric station and seeing the machines than we can explain to you by a paragraph in Notes and Queries.

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(Continued on page 14)

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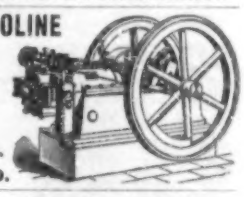

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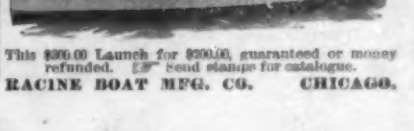

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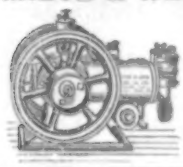

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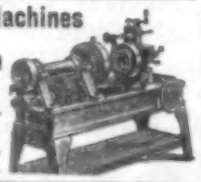

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(Continued on page 16)

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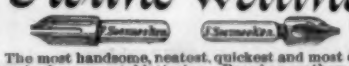

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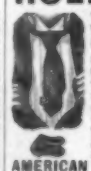

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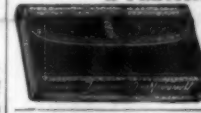

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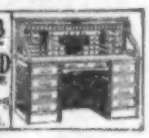

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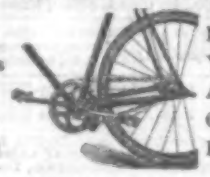

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